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THE AIR SHIP DIVISION OF THE GERMAN ARMY.

IT is very seldom that the general public knows anything about the air ship division of the German army, which is continuously working and experimenting on one corner of the Tempelhof Field, whence ascensions are made. Even Berliners rarely have an opportunity of seeing any of the maneuvers of this department, with its wagons, well drilled soldiers and peculiar apparatus.

But one thing is certain, and that is that in case of war it would be found that Germany was not behind the other nations in her inventions and arrangements. The armies of the Triple Alliance have adopted a uniform system for filling and transporting balloons, the Majert-Richter system being now used by Germany,

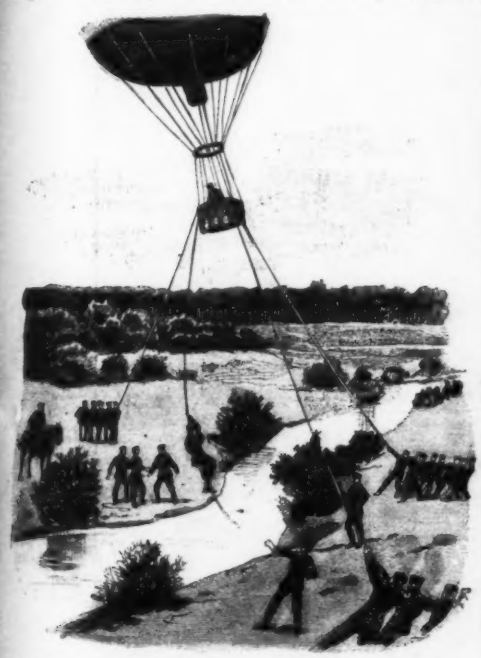


FIG. 1.—CROSSING A STREAM WITH A BALLOON.

Austria and Italy, while the other European states employ the Yong system.

The balloons are filled with hydrogen gas, which is manufactured by the department in a little building on the grounds; but in case of a campaign a whole gas-making plant could not be carried from place to place, nor has this been possible during maneuvers. Therefore, the gas necessary for filling the balloons must be carried in steel cylinders, which look almost exactly like those used for transporting liquid carbonic acid gas. These steel cylinders are about 8 feet long and have a diameter of about 5 inches; the gas in them is under a pressure of from 100 to 120 atmospheres.

Engraving No. 2 shows the operation of filling a balloon during maneuvers. The wagons which carry the steel cylinders have formed a circle around the balloon to be filled, and one cylinder after another is connected with its interior by means of a hose. We see the balloon already half filled, and as it is being filled from five wagons at once, scarcely an hour will be required for the operation. During maneuvers and campaigns captive balloons will generally be used, recourse being

FIG. 5.—DANGEROUS DESCENT.

had to free balloons only in cases of abandoning a stronghold or a blockaded station. The newspaper reports keep the public well informed in regard to the ascensions of free balloons, and our engraving No. 5 gives a vivid idea of some of the dangers that may be incurred when the descent cannot be managed as desired on account of storm, the closing in of night or other unfavorable conditions. The balloon shown here has descended in a pine wood and become fast among the tree tops. One man is letting himself down by the anchor rope, so as to go for assistance and also to make an anchorage.

Captive balloons are generally used in the open field also. In pleasant weather a balloon can ascend to a height of more than 1,900 feet, and from this height fine observations can be made. With good glasses the uniforms of advancing troops can be discerned when they are still at a distance of 9 miles. Reports are sent down from a captive balloon by a telephone, the wire of which is concealed in the anchor rope. Sketches and written information are sent down in tin boxes also by means of the rope. A balloon can be held by a single strong but not very thick cable,

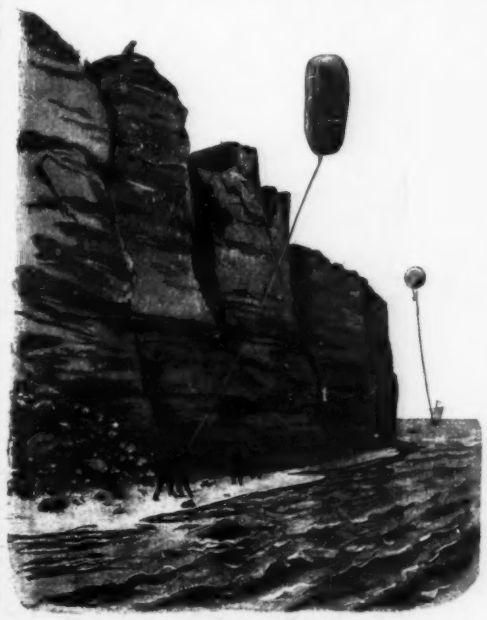


FIG. 4.—TRANSPORTING GAS IN BALLOONS ON THE COAST.

but a special wagon with a windlass must be provided for drawing the balloon down at a regular, even rate, the cable being wound on the drum. If the balloon mounts only to a height of from 300 feet to 600 feet—and when there is wind it is scarcely possible to reach a greater height—the wagon with the windlass is unnecessary, and in that case the balloon is provided with four ropes that are held by men. By means of these four ropes the balloon can be moved here and there over the field, the men marching about with the ropes.

This moving of the balloon is very important in case of an emergency, for even when at a height of 9,800 feet a balloon is within reach of the shots of the infantry, and the fire of the artillery can reach it from a distance of three miles. The falling of a balloon (this is

FIG. 2.—FILLING A BALLOON DURING MANEUVERS.

FIG. 3.—A BALLOON SUNKEN IN A PIT.

not very dangerous, as the balloon sinks slowly) can only be prevented by continuously changing its position. It is interesting to see how the men manage to get over obstacles in moving the balloon from place to place. Our engraving No. 1 shows the men crossing a stream. One man after the other swings himself across on one of the ropes, and then throws the rope back to the next man, until all of the men belonging to one rope have crossed, then those holding the next rope follow, etc. When bridges, especially railroad bridges, have to be crossed during the march, the same system is followed. They are passed by means of the so-called "split rope."

Engraving No. 3 shows a captive balloon that has been drawn down to the ground during maneuvers and is to be sent up again. A deep hole has been dug and more than half of the balloon let into the damp earth, so that the coolness will condense the gas and its escape through the fabric will decrease. The next morning it will only be necessary to refill the balloon from the steel cylinders, and it will be ready for ascension. In places that cannot be reached by the wagons with the cylinders, for instance, on the coasts (experiments with captive balloons have also been made on warships), or in the mountains, the cylinders are emptied into little balloons, as shown in engraving No. 4, which are then transported to the large balloon into which their contents are emptied.—*Illustrirte Zeitung.*

KRUPP ORDNANCE.

THE ordnance exhibit of Essen, at Chicago, says *Engineering*, was certainly the most complete and splendid that has ever been seen in the United States of America; probably it was the most important ever made at an International Exposition by any single manufacturer of ordnance. It was contained in a pavilion erected near the east front of the Agricultural building, and quite remote from the Transportation exhibits building, to which it belonged. This pavilion was about 200 ft. long, 42 ft. high, and 82 ft. wide. It was designed and constructed in Germany, and shipped to Chicago complete for erection. The contents comprised a large series of ordnance, from the great 120 ton gun to the smallest calibers for mountain service; a large display of projectiles, a series of armor plates, and a great number of rolled and pressed objects in steel, prominent among which were the frames and trucks of rolling stock referred to elsewhere. The most conspicuous object in the ordnance collection was the 120 ton gun, which presented a monumental appearance in the center of the hall.

THE 42 CENTIMETER (16·54 IN.) GUN.

The 42 centimeter gun was built for coast defense service, but it is more likely to remain as a monument to the wonderful producing power of Essen than to come into active use as a weapon of offense. A few particulars of this magnificent piece of ordnance may be added. The breech mechanism is of the standard type, with rounded sliding wedge block, and the charge is fired by a friction fuse. The following are some of the chief dimensions:

Caliber	16·54 in.
Length of barrel	45·93 ft.
Length of bore	41·66 ft.
Number of grooves	120
Weight of barrel with breech	120·46 tons

Four classes of ammunition were made to be fired from this gun: cast iron shells, steel shells, armor-piercing projectiles, and steel shrapnel; the weights of these varied from 2204 lb. to 2513 lb. The weights of the bursting charges of the various projectiles were as follows:

Cast iron shell	72·75 lb. and 88·18 lb.
Steel shell	119·04 lb. and 143·29 lb.
Armor-piercing shell	22·04 lb. and 27·55 lb.
Shrapnel	22·04 lb. and 25·13 lb.
Number of balls in shrapnel	3000 and 4000
Weight of each ball	3·52 oz.

As stated above, there have been 16 rounds fired from this gun, and the following results were obtained from the experiments made:

Weight of projectile	2204 lb.
Powder charge	908·8 lb.
Initial velocity (feet per second)	1981
Total striking energy	60,002 foot tons.
Energy per kilogramme (2·2 lb.) of barrel	1089·42 foot pounds.
Maximum range with 10·5 deg. elevation	9680 yards.

Perforating power of steel shell on wrought iron plate:

At muzzle	3·53 ft.
At 3281 ft.	3·26 ft.
At 6562 ft.	3·01 ft.

At the Exposition the gun was mounted on a front pivoting carriage, the rear part of the mounting being supported on four rollers traversing on a curved roller path; this formed the lower part of the mount. The gun itself was supported on an upper carriage, which could be moved to and fro on the inclined slides of the pivoted mount. A toothed quadrant is attached to the side of the gun, and it is raised and lowered by a train of handworked gearing engaging in this quadrant. Horizontal training is effected by a pitched chain and gearing operating on the back of the underframe. The recoil is taken up by hydraulic brakes, the piston rods of which are attached to a cross frame on the upper carriage, the brake cylinders themselves being on the lower carriage. The gun and upper carriage are run out by means of a chain and windlass.

The first two columns of figures below refer to the steel armor-piercing shell, fired with brown prismatic powder (initial velocity, 2021 ft.) and the smokeless powder (2234 ft.) against a wrought iron plate; the last two rows of figures refer to shell fired against a steel plate with similar velocities:

	In.	In.	In.	In.
At the muzzle	39·09	45·66	25·75	29·09
At 1094 yards	35·71	45·58	23·62	27·29
At 2187 yards	32·48	38·03	21·62	25·08

THE 28 CENTIMETER (11·02 IN.) GUN.

The 28 centimeter (11·02 in.) gun that was exhibited is also intended for coast defense, and is an admirable example of Krupp's recent practice. It is of the 1889 pattern, and is 40 calibers in length. The following are some of the leading particulars:

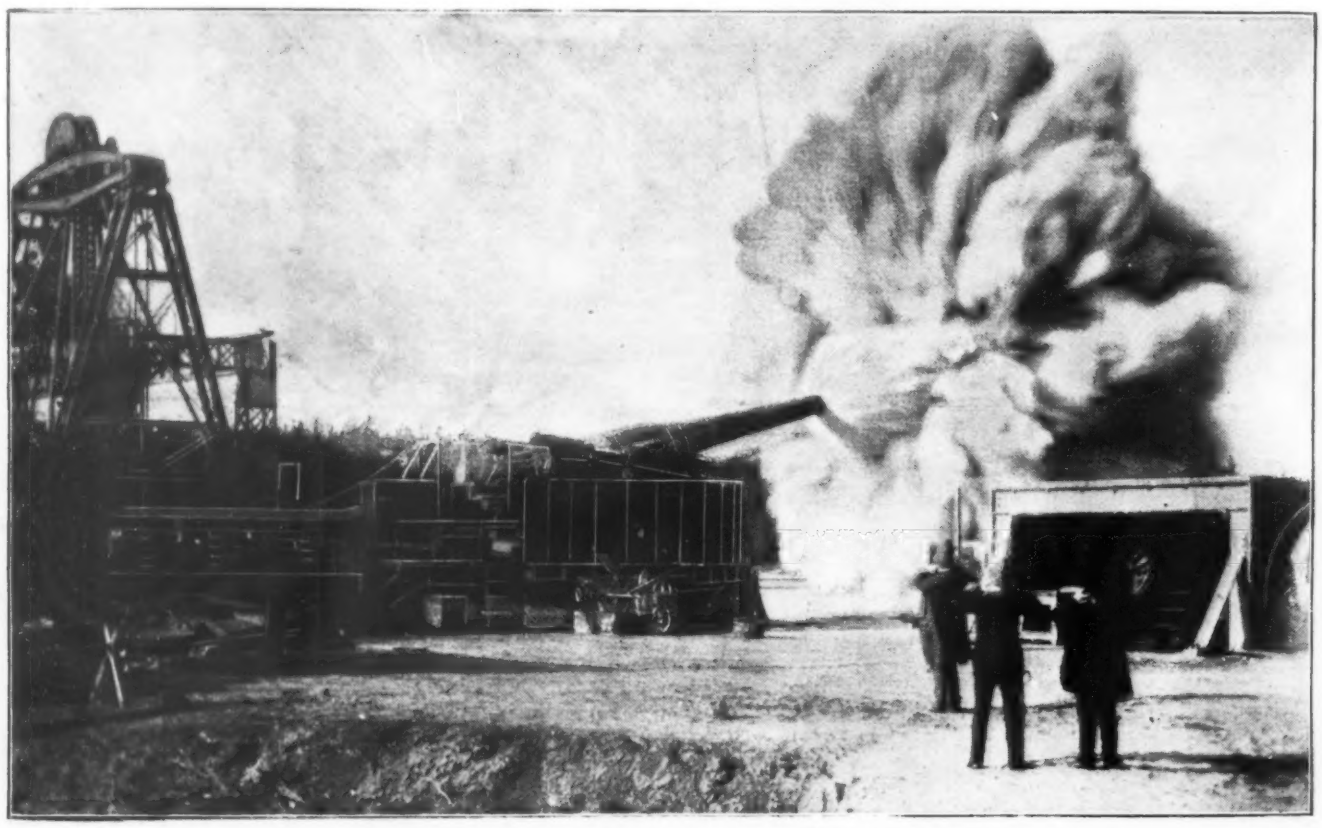
Caliber	11·02 in.
Length of barrel	36·75 ft.
Length of bore	33·99 ft.
Number of grooves	84
Weight of barrel and breech	42·62 tons.

The weight of the loaded projectile fired from this gun is 760·59 lb., and the following are particulars of the four kinds of shell employed:

Cast iron shell, bursting charge	25·35 lb.
Steel shell, bursting charge	44·09 lb.
Armor-piercing shell, bursting charge	7·94 lb.
Steel shrapnel, bursting charge	7·61 lb.
Number of balls in shrapnel	1030
Weight of each ball	0·22 lb.

Firing experiments made with this gun gave results which may be summarized as follows:

Weight of projectile	760·59 lb.
Weight of charge (prismatic powder)	332·74 lb.
Initial velocity	3067 ft.
Total energy at muzzle	22,536 foot tons.
Total energy at 1094 yards	19,683 foot tons.
Total energy at 2187 yards	16,145 foot tons.
Energy per kilogramme weight of barrel	0·52 foot ton.
Maximum elevation	45 deg.
Range at maximum elevation	22,300 yards.



FIRING THE ONE HUNDRED AND TWENTY TON GUN.

As already stated, the gun is interesting as a specimen of magnificent workmanship, rather than as an example of efficient ordnance or of the modern practice at Essen.

THE 30 CENTIMETER (12·01 IN.) GUN.

The following are some of the particulars of this gun:

Caliber	12·01 in.
Length of barrel	35 ft. 1·2 in.
Length of bore	32 ft. 0·6 in.
Number of grooves in rifling	68
Weight of barrel and breech mechanism	61·46 tons.
Maximum elevation	13 deg.
Maximum depression	5 deg.
Weight of carriage	58·15 tons.
Weight of shield	11·81 tons.

Four different classes of projectiles are fired from this gun, and there are two types of each projectile, the heavier weighing 1003 lb., and the lighter 725·3 lb.

Cast iron shells, bursting charge	35·27 lb. and 29·76 lb.
Steel shells, bursting charge	59·53 lb. and 44·09 lb.
Armor-piercing shells, bursting charge	10·58 lb and 9·7 lb.
Steel shrapnel, bursting charge	10·3 lb and 7·25 lb.
Number of balls in shrapnel	1360
Weight of each ball	0·22 lb.

Some of the ballistic data of this gun are given below:

1. Weight of projectile	1003·9 lb.
Powder charge, brown prismatic	429·99 lb.
Initial velocity	3021 ft.
Total energy	28,415 foot tons.
Energy per kilo. of weight of gun	1019·13 foot pounds.
Maximum range, with elevation of 13 deg.	10,827 yards.
2. Weight of projectile	1003 lb.
Powder charge, smokeless cube	227·07 lb.
Initial velocity	2234 ft.
Total energy	34,738 foot tons.
Energy per kilo. of gun	1245·52 foot pounds.
Maximum range of elevation 13 deg.	11,975 yards.
Penetrating power of armor-piercing shell striking at right angles an iron plate at muzzle	39·09 in.

Under the above conditions, the penetrating power of the armor-piercing shell in a wrought iron plate is as follows:

At the muzzle	34 in.
At 1094 yards	30·74 in.
At 2187 yards	27·8 in.

This gun, which was finished only in 1892, is provided with a vertically rising breech block. Although specially designed for coast defense service, it can, with a modified arrangement of the ammunition hoist, be employed for naval service. The mounting is peculiar in affording a very great range of elevation—from plus 45 deg. to minus 5 deg. The mounting is carried on a turntable placed on a live ring of steel balls, and the under carriage is secured to this table: upon this are placed the slides, which in their turn support the upper carriage. The slide is carried at its forward end on journals, and in the center by a cross frame, to which is connected the plunger of a hydraulic cylinder; by raising and lowering this plunger the desired elevation is given to the gun, which is lifted together with the slides and upper carriage. The brake cylinders are placed one on each side of the slides; they are connected with the upper carriage by means of projections on the underside of the latter to which the ends of the brake piston rods are attached. The loading device is operated by hydraulic power, which, as well as the mechanism for working the breech, is controlled from a platform on the turntable. The gun and mounting are protected by a domed turret, also carried by the turntable.

The weight of the shield is 23·62 tons, and of the carriage 59·05 tons.

THE 24 CENTIMETER (9·45) IN. GUN.

The next was, perhaps, the most interesting gun of the series. This was the 24 centimeter (9·45 in.) gun,

40 calibers in length, and built on the 1886 pattern; the breech mechanism is of the standard Krupp type. The following are some of the leading particulars of this gun:

Caliber	9·45 in.
Length of barrel	31 ft. 6·13 in.
Length of bore	29 ft. 1·75 in.
Number of grooves	56
Weight of barrel with breech mechanism	30·51 tons.

The ammunition fired from this gun is similar in character to that used in the other guns shown, the weights being 353 lb. and 474 lb. The bursting charges of the different shells are as follows:

Cast iron shell	15 lb. and 11·68 lb.
Steel shell	26·4 lb. and 21·16 lb.
Armor-piercing shells	No bursting charge
Steel shrapnel	4·75 lb. and 3·53 lb.
Number of balls in shrapnel	650 and 217
Weight of each ball	3·52 oz. and 10·58 oz.
Powder charge—prismatic	254 lb.
Powder charge—smokeless	92·7 lb.

This gun is remarkable as having given the longest range recorded by any trials, with a projectile of the weight specified. During some firing trials at Meppen, carried out in the presence of the German Emperor, on April 28, 1892, a range of 22,120 yards was obtained (over 12½ miles). The elevation on this occasion was 44°; the duration of flight of the shot 70·2 seconds; and the height of trajectory, 21,456 ft. On the walls of the Krupp pavilion was shown a diagram of this famous round, illustrating the line of trajectory referred to the height of Mont Blanc, and shows that if the gun had been placed at Pre St. Didier in the Alps, and directed at Mont Blanc with an elevation of 44°, the shot would have fallen in the vicinity of Chamounix, after having passed 5675 ft. over the summit of Mont Blanc, which is 15,781 ft. above the level at which the gun would have been fired.

The following are some of the results obtained with firing trials of the 24 centimeter gun:

1.	Weight of projectile	352·7 lb.
	Nature of powder	Brown prismatic
	Weight of charge	253·53 lb.
	Initial velocity	2510 ft.
	Nature of powder	Smokeless cube
	Weight of charge	2623 lb.
2.	Weight of projectile	473·97 lb.
	Nature of powder	Brown prismatic
	Weight of charge	253·53 lb.
	Initial velocity	2100 ft.
	Total energy	14,482 foot tons
	Energy per kilogramme of gun	0·467 foot ton
	Maximum range, elevation 25°	15,092 yards
	Maximum range, elevation 44°	21,872 yards
3.	Nature of powder	Smokeless cube
	Weight of charge	92·59 lb.
	Initial velocity	2300 ft.
	Total energy	17,328 foot tons
	Energy per kilogramme of gun	0·559 foot ton

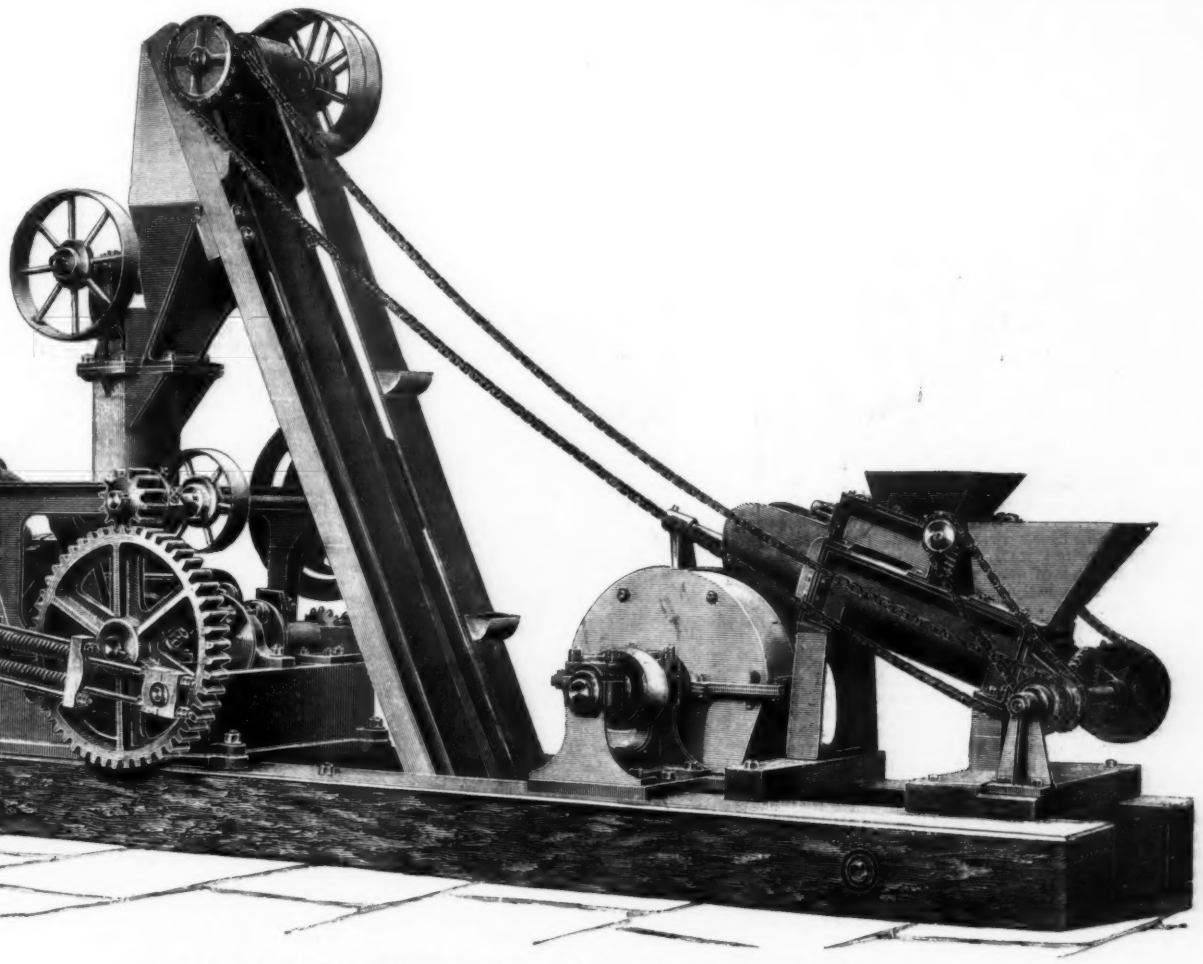
THE 21 CENTIMETER (8·26 IN.) GUN.

The 21 centimeter (8·26 in.) gun was exhibited mounted on a center-pivoting naval carriage. The length of the gun is 35 calibers, and it is specially intended for large gunboats or the smaller class of ironclads. The mounting possesses some features of special interest; it consists, as usual, of the upper carriage, the underframe, and the turntable. The gun is mounted by its trunnions in the upper carriage, in the sides of which the hydraulic brake cylinders are formed, the piston rods of these cylinders being attached to the forward end of the lower mounting. The turntable to which this latter is attached revolves on a central pivot, and is supported on a live ring of steel balls. The gun can be revolved horizontally with gearing worked by hand; the elevation of the gun is effected by means of a toothed arc attached to the gun, and suitable gearing. Connected with the hydraulic brake of the carriage is a running-out brake by which the gun is held at the end of the recoil, or it may be held in any desired position upon the slides. Besides the hand training gear the mounting is supplied with an electrical driving device for effecting all the necessary manipulations, including the projectile crane. An electric motor mounted on the left side of the frame operates the elevating gear, while the motors for the horizontal training, and for working the ammunition crane, are placed on the right hand side of the mounting. The electrical and hand gears can be thrown in or out of service at will. The gun and carriage are protected by a steel shield 0·98 in. thick attached to the turntable. The maximum elevation that can be given to this gun is 25°, and the maximum depression is 5°. The weight of the mounting is 14·90 tons, and that of the shield is 6·98 tons. The following data refer to the ammunition employed with this gun:

Weight of projectiles	308·6 lb. and 238·1 lb.
Cast iron shells, bursting charge	11·02 lb. and 8·82 lb.
Steel shells, bursting charge	18·74 lb. and 14·33 lb.
Armor-piercing shells, bursting charge	3·09 lb. and 3·09 lb.
Steel shrapnel, bursting charge	3·09 lb. and 2·43 lb.
Number of balls in shrapnel	975
Weight of each ball	0·11 lb.

Both brown prismatic and smokeless powders are used with this gun, the charges being 51·8 lb. of the former with a 238 lb. projectile, and 50·7 lb. of the latter with a 308·6 lb.; the maximum ranges, with an elevation of 25 degrees, are respectively 14,436 and 15,037 yards; the total striking energies are 9,012 and 9,616 foot tons.

Up to the date of the exhibition the 21 centimeter gun shown had fired 74 rounds with full charges at the practice grounds at Meppen; of these, 40 rounds were fired with brown prismatic, and 34 with smokeless powder.



IMPROVED MACHINERY FOR MAKING BRIQUETTES.

BRIQUETTE MACHINE.

THE illustration shows one of the latest designs in briquette machines made by Mr. Robert Middleton, Leeds, and given in a recent number of *Engineering*, with the following particulars. Hitherto Mr. Middleton has made these machines of large size only turning out 5 tons per hour, but a demand for smaller ones having arisen, they are now made in four sizes, from half a ton per hour upward, specially adapted for coal merchants, who, with small manufacturers, will, it is anticipated, find them very useful and convenient. The briquette made is of a small handy size, and adapted for household purposes, weighing, as desired, from ¾ lb. to 3 lb. each, and the whole plant is placed upon a strong wooden frame which requires no foundations and makes the whole installation self-contained.

The plant shown consists of a mixing and measuring machine, a disintegrator, a set of chain elevators, and the briquette machine itself.

The coal and pitch, or other binding material, are first fed into the mixing and measuring machine in which the required percentages of both coal and agglomerant are measured and mixed together. The percentages can be varied by means of change wheels on the machines, so as to suit different classes of coal or agglomerant, or deal with more agglomerants than one at the same time. From this the materials fall through a hopper into the disintegrator, inside the cover of which are steel cages fitted with steel bars. These cages are driven in opposite directions at a high speed, grinding and mixing the materials together thoroughly. The bars in the cages are made replaceable, so that when worn they can be easily taken out and replaced with new ones, which is a great improvement over machines with fixed bars, saving a large expense in repairs.

After being thoroughly ground and mixed together in the disintegrator, the materials fall into the elevator box, and are lifted by the elevator into the vertical heater of the briquette machine. Here they are again mixed together, and heated by steam which is injected either into the materials or into a steam jacket, as desired. This heater is fitted with adjustable knives working on a vertical shaft, which pass the materials into the pugmill of the machine. From this they are fed into the mould plate in measured quantities, they are pressed in moulds, and are turned out in the shape of finished briquettes ready for using. The ability of the machine to turn out consecutively briquettes of the same size and weight is an important factor where they are disposed of retail by number and not by weight. The machine is designed on the same principle as the large ones. In it the briquettes are subjected to two different pressures, are pressed on both sides simultaneously, the pressure applied equaling about two tons per square inch. This insures the briquettes being solid and firm, and enables a saving to be made in the amount of pitch or other agglomerant used, as it has been found, after extensive experiments, that this pressure, applied to both sides simultaneously, is the best that can be used for this purpose. The pressing itself is done by leverage only, no steam being used excepting for heating the materials to a plastic state. The corners and edges of the briquette are all rounded off on both sides, thus giving it a better appearance and saving the loss in weight in transit which is occasioned by the crumbling away of square edges. It will be seen that the process is entirely automatic after the materials are first fed into the measuring machine. Very little power is required for driving the whole plant. These machines are not designed simply for using pitch as the agglomerant, but various other binding mixtures can be utilized equally as well.

TRANSPARENT CONDUCTING SCREENS FOR ELECTRIC AND OTHER APPARATUS.*

IT is well known that electrostatic instruments require to be screened from outside electric disturbance, in order that their indications may be correct; but it is not so generally recognized that instruments intended to measure small forces, such as certain types of electro-magnetic voltmeters, delicate vacuum gauges, etc., are liable to give wrong readings from an electric attraction being exerted on the pointer, such as is produced by the glass cover when it is touched or cleaned.

There is on the table here a well known type of gravity electro-magnetic voltmeter, which may be found on the switchboards of many English and Continental electric light stations. At the present moment its terminals are not connected with the electric

* A paper by W. E. Ayrton, F.R.S., and T. Mather, read at the Institution of Electrical Engineers on April 12.—*Nature.*

light mains of the building, so that it should indicate zero pressure. Let me, however, but stroke the right hand side of the glass cover with my finger, and the pointer, as you see, at once turns to eighty volts or more. Conversely, let the terminals of the voltmeter be connected with the electric light mains; the pointer should point to about 100 volts, for that, as you know, is the pressure supplied by the Westminster Company. The voltmeter appears to be indicating correctly, but, on stroking the left hand side of the glass cover, the pressure, as read by the instrument, appears to suddenly fall to some forty volts. And a similar effect is produced if a piece of wash leather or dry waste be used in place of the finger.

If, then, it is possible to cause this instrument to indicate at will sixty or eighty volts too high or too low, how impossible must it be to feel sure that the glass cover—which is, of course, maintained in a dry condition in a hot engine room—has not been electrified by some accidental touch of the coat sleeve sufficiently to cause an error of three or four per cent. in the reading of this voltmeter!

We find that it is not merely with this particular type of voltmeter that an error can be produced by stroking or rubbing the glass cover, for other electromagnetic instruments that we have tried can also have their pointers deflected in the same way, but not to the same extent.

Nor, of course, is this source of error in any way connected with a voltmeter being an instrument constructed to measure an electrical magnitude, for it would equally exist if the glass were clean and dry and the controlling force remained of the same magnitude, no matter what was the quantity the instrument was constructed to measure. For example, on the table there is a vacuum gauge the wheel sector pinion of which has been replaced with an Ayrton-Perry magnifying spring. This gauge is, no doubt, very sensitive, for you observe that the pointer moves even when I produce an extremely slight diminution of pressure by rotating the short length of India rubber tube as slowly as I can; the change of pressure on pinching the tube, or even on dropping it, is indicated by the pointer. On the other hand, the pointer is of glass, and, therefore, is not suitable for being acted on by an electrostatic force; still, a stroke on the glass cover, as you see, causes the pointer to deflect through several degrees.

It has been known for a long time that it is possible to screen an instrument from such outside electrostatic disturbances by surrounding it with a metallic cage composed of wire or of strips of tinfoil. Such a method of screening, however, has the great disadvantage that it renders it difficult to observe the exact position of the pointer from a distance, for the wires or strips of tinfoil cover up the pointer more or less. We, therefore, thought of placing the pointer underneath the metallic dial of our electrostatic voltmeters, and of only allowing the tip to project through a slot in the dial plate. But this method we abandoned on trying it eighteen months ago, for to make the screening good the visible part of the pointer must be reduced to a spot, and the exact position of this spot we found less easy to read at a distance of several feet than that of a long black line, which is the appearance of a pointer when it is visible along its whole length. This method of screening has, however, we understand, been recently adopted by a firm of instrument makers.

We next considered whether it was not possible to make a perfectly transparent conducting screen, so that, while the electrostatic screening of the pointer should be practically perfect, the pointer and dial should be as easily seen as if the screen were not present. Our first idea was to make the glass cover double, and to insert between the two sheets of glass a layer of clear conducting liquid. Fearing, however, trouble from leakage of the liquid, or from the liquid becoming gradually turbid and giving the dial a dirty appearance, we turned our attention to depositing films of solid matter on the inside of the glass cover or shade, of sufficient thinness to be practically transparent, but with the solid particles near enough together to be conducting. We tried smoke, silver deposited in layers of various thicknesses, mercury vaporized and deposited, sal-ammoniac vaporized and deposited, etc., but we were quite unable to obtain in this way both transparency and electric conduction.

After a conversation with Prof. Boys, when discussing the problem that we were then engaged in solving, we commenced experimenting on varnishes, with the view of arriving at a varnish which should be as hard and as transparent as clear shellac, but which, instead of being an insulator like shellac, should be a sufficiently good conductor to allow of the instantaneous production of an induced electric charge to balance the electrostatic action of any outside body. Glass plates were coated with gum, with coaguline, with the gelatinous electrolyte used in accumulators (composed of sodium silicate and dilute sulphuric acid), with isinglass dissolved in acetic acid, with gelatine dissolved in acetic acid, with isinglass dissolved in a mixture of acetic and sulphuric acids, and with gelatine dissolved in the same mixture. After much experimenting, we arrived at the following two methods of coating a glass cover, or shade, which gives perfectly satisfactory results:

No. 1.—Dissolve ¼ ounce of transparent gelatine in 1 ounce of glacial acetic acid by heating them together in a water bath at 100° C. To this solution add half the volume of dilute sulphuric acid which has been prepared by mixing 1 part of strong acid with 8 of distilled water by volume, and apply the mixture while still warm to the glass shade, which should be previously polished and be warm. When this film has become very nearly hard, apply over it a coating of Griffith's anti-sulphuric enamel.

Method No. 2.—Thin the gelatine solution, prepared in the manner previously described, by the addition of acetic acid (say 2 volumes of acid to 1 of the solution), and, after polishing the glass, float this thinned solution over the glass cold. Drive off the excess of acetic acid by warming, allow the glass to cool, and repeat the floating process, say, twice. Thin the anti-sulphuric enamel by the addition of ether, and float it over the gelatine layer applied as just described. Expel the ether by heating, and apply a second layer of this thinned anti-sulphuric enamel.

With experience, such as Messrs. Elliott and Messrs. Paul have at length acquired after much practice, a layer can be applied, either according to method No. 1 or No. 2, so that, when finished, it is quite hard to the touch, and so transparent that it is only by looking at the glass plate obliquely that the presence of the varnish can be detected.

It is also so conducting that when a P. D. of several thousand volts, alternating with a frequency of 200, is set up between the needle and inductors of one of our electrostatic voltmeters, the pointer, which is metallically part of the needle, is not visibly attracted by a metallic rod held just outside the glass close to the pointer, this metallic rod being electrically connected with the stationary inductors.

Without experience, however, it is somewhat difficult to apply the coating so that it is not either cloudy or a comparatively poor electrostatic screen or both.

This second electro-magnetic voltmeter—which, like the former, has been kindly lent us by Mr. Barley, of the Knightsbridge electric light central station—looks exactly like the other one, and, indeed, behaved exactly like the other one when we received it. It has, however, had a layer of our transparent varnish applied on the inner side of the glass subsequently, and you will find that you may rub the glass as much as you like, or even hold a rubbed stick of ebonite near it, without producing any effect on the pointer.

Again, these two clear glass shades, belonging to gold leaf electroscopes, are one of them coated with our varnish, and the other not. Which is the uncoated one is at once apparent from the alteration produced in the deflection of the gold leaves when I approach a stick of rubbed ebonite near the lower part of the glass shade of the uncoated one, for no such change in the deflection is produced, as you see, when the ebonite rod is brought near the glass shade, which is protected by a layer of this varnish applied on the inside.

IMPROVED STEREO-MATRIX PROCESS.

A DEPARTURE from the present method of forming stereotype moulds for newspaper and other classes of printing work has, according to *Engineering*, recently been devised and patented by Mr. G. Eastwood, of Norwich, Eng., and has, we are informed, been already applied practically at several important offices. The principal objects which the patentee had in view in working out this process were to dispense with the present methods of "beating" and "mangling" the matrix, and to expedite the drying of this matrix, in order to promptly release the form and to get the mould quickly into the casting box. The benefit to be secured by such ends may be gathered from the fact that, according to the present, or "beating," etc., process, some seven to twelve minutes are occupied in the moulding and drying of a matrix, while it is claimed that by Mr. Eastwood's invention the moulds can be made ready to be cast from in less than half a minute. If really satisfactory moulds can be produced in anything like this time, the matter is, of course, one of great importance.

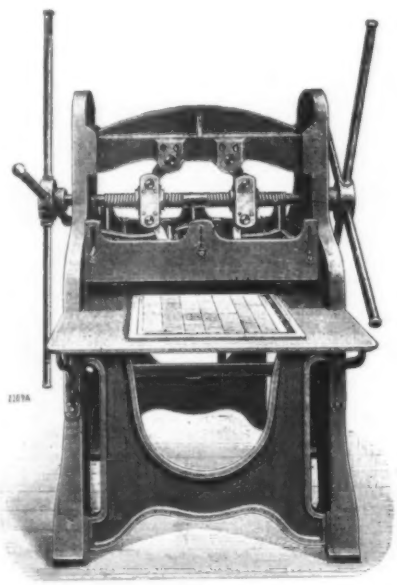
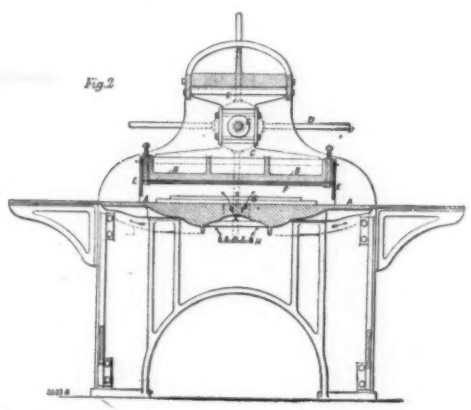


Fig. 1



IMPROVED STEREO PRESS.

The majority of daily newspaper readers may scarcely realize the fact that the type as "set up" in the composing room of most offices never touches the ink or the paper which is used to form the news sheets; that which produces the reading matter is simply an exact impression or mould of the type page in solid metal, called the "stereotype," cast in such a way as to be suitable for attachment to the cylinders of the rotary machine. No matter to what perfection the printing machine or composing contrivances may be brought, in order to meet the requirements of the times, stereotyping is and will be necessary to complete the "connection," and the more perfect it is in saving time and performing the work in a satisfactory manner, the more valuable will the rotary machine become as a rapid printing appliance.

According to the ordinary methods of obtaining moulds from type, etc., from which in turn the "stereo metal" castings are taken, the hot or cold wet or moistened "flong" is, after being laid upon the type, beaten with hand brushes and then rolled, after which it is, with the "form," placed under a press mounted on a steam heated slab. The form with the mould on it remains on this slab until the mould is dry or nearly so. These operations, as before mentioned, necessarily occupy several minutes to carry out.

The essence of Mr. Eastwood's method consists in the substitution of a single press, with platen action, for the above mentioned appliances for beating, mangling, and drying. The type bed of his new press forms also the base of the heating chamber, while the platen adjusts the flong and removes it after pressure has been applied, suspending it in the drying chamber between heated currents of air. At the moment of contact with the type the flong is moist and plastic, and in the act of consolidating is heated so that the least possible time is taken in completing the drying. When the pressure is removed, the form is immediately released, either for duplicating the matrix or for removal to the composing room. "Packing" the mould to fix the "blanks" is said to be generally unnecessary, owing to the rapidity with which the composition of the flong is fixed; but this is a point on which we should be glad to learn the results of further experience.

The "flong," or materials in which the impressions of the type are taken, may roughly be said to consist of a layer or number of sheets of blotting or other paper pasted together, which in turn may, if desired, be covered by one or more sheets of tissue paper or muslin. According to the present existing practice the flong is often composed of some five or six separate layers of paper, whereas Eastwood's flong is formed of only two or three sheets. The compositions or agglutinating materials used in these productions are, more or less, the occult property and art of the stereotyper. Mr. Eastwood, however, says that the composition he employs is essentially one of an ordinary known character, although we are inclined to believe that there is more mystery in the flong itself than the patentee wishes at the moment to disclose, although it is protected.

Referring to the illustrations given herewith, Fig. 1 represents an end elevation of, and Fig. 2 a vertical section taken through, Mr. Eastwood's moulding press. A (Fig. 2) represents the metal type bed or table, which is heated by suitable means, and is supported upon a cast framing. B is the "platen" or top plate of the press, which works freely in vertical guides by means of the toggle lever movement, C, actuated by the right and left handed screw spindle, upon the extremities of which the starwheel, D, is keyed, so that hand power may be conveniently applied to the apparatus. To the platen are attached the end covers or inclosing plates, E, arranged so as to confine the heat as far as possible within the area of the former, when it is raised in order to allow the press to be opened; these plates are secured by bolts working in slots, as shown, in order to accommodate the vertical movement of the platen. The latter is connected with the toggle action by a free pin or knuckle joint to allow it to accurately adjust itself to the surface of the type. F represents a frame or "frisket" suspended by a spring-holding device immediately below the platen for carrying a "blanket" or cloth, while G indicates a "form" (*i. e.*, keyed up columns of type) in position for taking a mould.

The type bed, A, for receiving the "form" below the "platen," B, is heated from beneath by means of gas jets, H, the products of combustion being allowed to pass into the area confined within the bed, pressing plate, and covers, E, by suitably located slots or apertures, I, shown by dotted lines in Fig. 2, the arrows indicating the manner in which the heated air is caused to circulate. Obviously by raising or lowering the gas flames the temperature can be regulated to a nicety; it is stated that in practice the temperature need not exceed 200° F. It will, of course, be readily understood that, if desired, or more convenient, the press can be satisfactorily heated by means of steam.

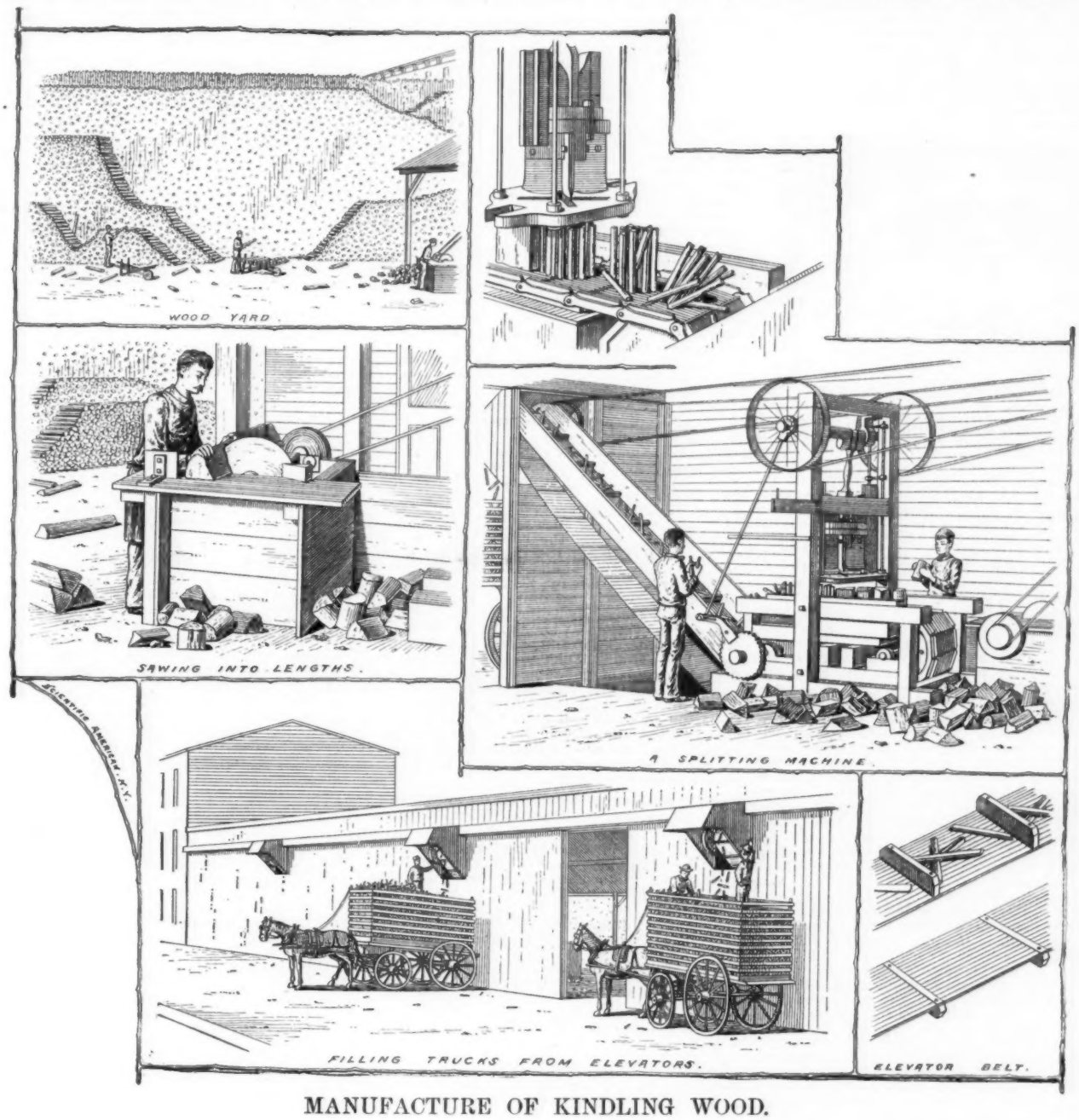
The form having been handed to the stereotyper, he places the moist flong upon the face of the type, and then inserts the latter into the machine, gradual pressure being applied by turning the handwheel, D. Immediately sufficient force has been exerted, he releases the platen and withdraws the form, and the process is complete, the time occupied being, as before stated, about twenty to thirty seconds. The mould is now ready for the stereo casting box in which the curved or flat metallic reliefs are obtained. The process being conducted between the hot bedplate, blanket, and platen, immediately the pressure is released the mould is finished ready for being cast from, although the temperature used seldom exceeds 175° F. This comparatively low temperature readily permits of impressions being taken from woodcuts or illustrations in an efficient manner without risk of cracking or breaking the blocks. The patentee attaches much importance to the freely mounted platen, which adjusts itself to the face of the type or block from which a mould is to be taken.

ONE of the chief men in a Mohammedan caravan is the cat sheik, or "Father of Cats," who rides a camel carrying dozens of baskets filled with cats.

STEAM KINDLING WOOD MANUFACTORY.

The pine kindling wood that is used in this section of the country comes principally from the forests of Virginia. The trees are first cut down and the trunks quartered and sawed into proper lengths. The wood is then carted to the coast, packed into sailing vessels and brought to this section, where it is bought up at the docks by the dealers and manufactured into kindling wood, being first sawed into short lengths, then passed through a steam splitter which carries the pieces to an elevator which in turn passes them along and drops them down into the delivery wagons. The pieces of timber, which are four feet six inches in length, are first sawed into eight and one-half inch lengths, the saws used for this purpose being thirty inches in diameter, one-eighth of an inch thickness, having fifty inch and a quarter teeth. These saws make about two thousand revolutions per minute, the attendant being able to saw up about from twelve to fifteen cords per day. The pieces as fast as they are sawed are passed to the steam splitter. They are first placed end up on to a movable endless chain, which, by the aid of two hexagon wheels and a ratchet wheel which is worked by an eccentric, causes the chain with the wood to move along under the knives, which pass down through the pieces of wood, splitting each of them into a dozen or more pieces. The knives are four in number and bolted into a cross head. They are twelve inches in length, six inches in width and three-quarters of an inch in thickness. The knives pass up and down a perpendicular slide with a twelve inch stroke, making about eighty cuts per minute. The endless chain is twelve inches in width and passes over a wooden bed, the top of which is covered with an iron plate which protects the chain from the blows of the knives when striking the wood. At every downward stroke of the knives a movable bearing which the knives pass through holds the pieces of wood down firmly against the chain. With the upward stroke it releases the split wood, which is moved forward about two inches at a stroke by the chain, which is worked by the ratchet wheel and eccentric. The pieces of wood then drop down into an elevator at the end of machine and are carried off to the delivery wagons by a number of buckets belted to a twelve inch cotton belt. These buckets are eighteen inches apart and made of wooden strips three inches in height, and about one and one-half inches in thickness. They are held in place by being bolted to narrow iron strip on the underside of belt. The belt is about thirty-five feet in length and travels about one thousand feet per minute. The splitting machine can cut about twenty cords per day. A delivery wagon holding about one cord can be filled in about fifteen minutes. The wholesale of Virginia pine at the dock is from $7 to $8 per cord, the manufactured kindling wood bringing from $11 to $13 per cord.

The sketches were taken from the plant of Clark & Wilkins, New York City.



MANUFACTURE OF KINDLING WOOD.

GASEOUS FLUORIDES.

A RECENT number of *Nature* states that a detailed account of his investigations concerning the gaseous fluorides of the simpler organic radicals is contributed by M. Meslans to the March number of the *Annales de Chimie et de Physique*. The fluorides of methyl and ethyl have already been fully described by M. Moissan and other workers, and the fluorides now described are those of the radicals propyl, isopropyl, allyl and acetyl, together with the interesting analogue of chloroform, fluoroform. Propyl fluoride may be obtained by reacting with the corresponding chloride, bromide or iodide upon anhydrous fluoride of silver. The iodide is most convenient, as it reacts at the ordinary temperature, while propyl bromide requires heating to the neighborhood of 100°, and the chloride to a still higher temperature. The reaction between propyl iodide and silver fluoride may be best carried out in a copper tube immersed in tepid water. The propyl iodide is admitted to the tube already containing the silver fluoride from a dropping funnel, and the gaseous product of the reaction passes upward through a leaden condensing worm cooled by iced water and subsequently through three U-tubes containing fragments of silver fluoride, and finally through a delivery tube to the mercury trough over which the gas is to be collected. The reaction does not simply result in the formation of propyl fluoride and silver iodide. A third substance is produced, a red solid substance which is found to be an iodo-fluoride of silver of the composition Ag_2FI. The amounts of propyl fluoride and of the latter substance obtained correspond to the equation

$$C_3H_7I + 2AgF = C_3H_7F + Ag_2FI$$

Propyl fluoride is a colorless gas possessing an odor similar to that of the analogous chloride. It burns with a brilliantly luminous flame forming aqueous vapor, carbon dioxide and hydrofluoric acid. It liquefies at — 3° at the ordinary pressure to a colorless mobile liquid which is without action upon glass. The difference of boiling point between this liquid and propyl chloride (+ 45°) is 48°, about the same as that between ethyl fluoride and chloride, and almost twice as great as that between the chlorides and bromides of the two radicals. The gas is decomposed by melted sodium, with sudden and brilliant incandescence, accompanied by deposition of carbon. It is soluble in water to the extent of one and a half times the volume of the latter. Isopropyl fluoride and allyl fluoride are prepared in a similar manner from the corresponding iodides. They are both gaseous substances capable of condensation to liquids by reduction of temperature or augmentation of pressure. A mixture of allyl-fluoride with four times its volume of oxygen explodes with great violence under the agency of an electric spark, or when brought in contact with a flame.

Fluoroform, CHF_3, has been prepared in the pure state by M. Meslans only after repeated unsuccessful attempts. When free fluorine from the platinum delivery tube of the electrolysis apparatus is allowed to escape into chloroform an energetic reaction occurs, chlorine is liberated, and in a few moments an explosion is produced, with copious formation of carbon tetra-fluoride and fluoroform. If the fluorine is caused to enter a vessel containing air charged with vapor of chloroform, an immediate explosion is produced. When finely powdered silver fluoride and iodoform are mixed a vigorous reaction also occurs, usually with incandescence, and the fluoroform produced is contaminated with other gaseous products. The reaction may be modified, however, by adding chloroform and cooling with ice, and the gas may be purified from chloroform by passing through alcoholic potash, which is without action upon fluoroform, from carbonic oxide, which is usually present in small quantity, by means of a solution of cuprous chloride in hydrochloric acid, followed by desiccation over fused potash, and finally from last traces of impurities by passage over silver fluoride heated to 150°. The gas thus treated is pure fluoroform, a gas which liquefies at 0° under a pressure of twenty atmospheres. It is incombustible, but imparts a bluish green color to a Bunsen flame when injected into it. It is insoluble in water and possesses an odor similar to, but feebler than, that of fluoroform. The action of free fluorine upon it is interesting. A flame is produced at the end of the platinum tube delivering fluorine, and the one atom of hydrogen contained in the fluoroform is extracted and converted into hydrofluoric acid without any deposition of carbon, the latter element being at the same time entirely converted to the gaseous tetra-fluoride.

CHEMISTRY IN RELATION TO PHARMACO-THERAPEUTICS AND MATERIA MEDICA.*

By Prof. B. J. STOKVIS, of Amsterdam University.

THE TERM AND SCOPE OF PHARMACO-THERAPEUTICS.

"THERAPY" or "therapeutics," by which terms we understand the art of serving the cause of humanity by assuaging human suffering and healing human ill, avails itself of every means in its power to arrive at these ends; *elle prend son bien ou elle le trouve.* And the art of therapeutics, like all of us here assembled at this Eleventh International Medical Congress, has discovered that all ways lead to Rome. To Rome therapeutics has come, now in the guise of electricity, now as a water cure, now as psychical influence, so that we here are able to review, as they defile like armies before us, electro-therapy, pneumo-therapy, hydro-therapy, hypnopsis, and psychic suggestion, and compare their merits as healing agents when placing themselves at our orders to combat disease and put death to flight. But most ancient of all the branches of medical art is that which makes use of drugs; and in the hands of the inexperienced drugs can cause death (*Φαρμακεία*—the use of medicines or poisons), so that the science and art of the introduction of medicaments into the human body with the view of healing it carry with due right the appropriate title of "Pharmaco-therapeutics." And at one time, pharmaco-therapeutics was the most important branch of the healing art, though in our days it has declined and occupies but a second, or perhaps, I should say, third place; operative surgery, proud of its victories, and as admired as admirable, full of vigor and sap, has distanced the ancient branch. And again, we see hygiene, young, fresh, lovely, and assured beforehand of all suffrages, taking its place in the front of all medical science, confident in the future success of its attempts to render the arts of healing superfluous by preventing the malady. Why, then, it may be asked, do I essay to interest you in an art which seems to be growing old under our eyes; whose past, it is true, is very honorable, but whose future hardly seems to promise the triumphs that have fallen to the lot of surgery and of hygiene. My reply is simple—because we shall not be able to dispense with this essential branch of our art; because, as much in external as internal medicamentation, we must for the present make use of pharmaco-therapeutics.

THE PRIME IMPORTANCE OF CHEMISTRY.

The substances that we employ in medicine are composed of chemical bodies, or are, perchance, pure chemical bodies; and to understand their physiological action we must have recourse to biology and chemistry; while to appreciate their application in disease it is necessary to study pathology and therapeutics. Chemistry, in its wide sense, enables us to understand the composition, the structure, and what I would term the affinities of a substance, as it is chemistry that enables us to analyze by tests, and to construct and reconstruct by synthesis. The relations between chemistry on the one hand and pharmaco-therapeutics and materia medica on the other are so intimate, so indissoluble, and so obvious that it almost seems to me superfluous to trouble you with their consideration. However, you will not mind, I hope, if I take the liberty of submitting to you a few points which may not be new, but which at any rate have the merit of being *apropos*, and may by thought upon them make us better appreciate chemistry. To pile stones on the top of each other is not to construct an edifice. Without a definite plan, without a general view—that is, a comprehensive conception of the whole constructive scheme—there can be no scientific edifice durably reared. Therefore, it would not be sufficient to constitute pharmaco-therapeutics a science to say that if it has arisen without preconceived ideas, it is founded upon observations extending from the most ancient date with regard to the effects produced by the administration of certain substances to the sick; nor is it sufficient to claim that pharmaco-therapeutics has availed itself of experiments on healthy man and on animals, and has taken into consideration physiological results and the fruits of clinical study. A sound basis of operation from which to inquire into the use of medical substances is required. We must know, if we would satisfy the claims of science, the mode of action of these substances, and understand how it comes about that they possess the power to produce or remove functional troubles. And it is here that chemistry comes to our aid—chemistry in general, chemistry in its largest sense. I in no way lose sight of the incomparable services of biological chemistry and physiological experiment. Who of us would overlook the assiduous and successful work of Coppola, Gracosa, Pellacano, Albertoni, and of all that young Italian school that is now marching victoriously along the route traced out for them by Fraser and Brown? The method of action of medical substances has been and will be rendered more clear and comprehensible by their researches; but this is not enough. The conscientious striver after truth will always find himself face to face with one problem, a problem in the solution of which lie concealed—an inextricable secret so far—the true phenomena of life. We recognize this; for everywhere, where we are powerless to comprehend the action of medical substances upon the living organism as being due to their own inherent properties, we do not hesitate to call to our assistance the unknown properties of living protoplasm, and attribute the phenomena to them; but it is chemistry that should tell us that we must not be discouraged by the enigma of life. Enigma there is doubtless, but let us recall that Lavoisier first named life "a chemical function," and that—once given that the creature lives—from that it obeys neither more nor less than dead or material nature the general laws of chemistry.

VITAL PHENOMENA AND THEIR MEANING.

The familiar phrases "living force" or "vital phenomena" serve us to designate the outward expressions of condensed energy in dead material, being borrowed from the manifestations of life. In dead material, we are all aware, force can appear as thermal energy, as electricity, as light, or as mechanical expression, and we can go back along this line of transformations and see all the changes unmake themselves. In living protoplasm—considered as the unit of the psychic and reproductive functions—the essential phenomena are the same. There is the same change of *roles*, the same production of warmth, electricity, mechanical energy, and chemical energy. We know that the living cell "reacts," as we please to term it, to variations of temperature, electricity, light, and energy, chemical and mechanical; but this irritability in the cell, this aptitude of the cell to change one form of energy for another, resembles the transformations that take place in dead material, as the stimulants of the living cell, without which the vital phenomena do not appear, are just the different forms of energy which arrive to it from its environment, and which it changes into chemical energy.* For life the cell must have warmth and moisture. Take away the moisture or lower the temperature to the necessary point, and life becomes latent or disappears. In dead nature the same takes place. We are all familiar with the admirable experiments of Professor Pictet, bearing upon this point. He proved by them beyond dispute that chemical energy disappeared and reappeared in accordance with the temperature to which certain substances were submitted, and that water is every whit as indispensable as a proper temperature for the maintenance of the phenomena of life. Certain it is that life is a chemical function, but the point is, Is not the chemical function a sort of life? Did not the father of medicine show a wonderful insight in counting water and fire among the four elements of which the universe is composed?

Now if we examine closer the special problems which fall within the scope of pharmaco-therapeutics, if we examine the results which follow the introduction of drugs—healing or poisonous—into the organism of man and animals, it must appear that we can never learn how to solve the problems without looking for their explanation in these "vital elements," as I may term them. The manifestations of their agency in the behavior of living organism have so characteristic an imprint that even Claude Bernard himself did not hesitate to place chemical and purely physical action in the comparative background. I will give examples of my meaning. How are we to understand the fact that the ingestion of infinitesimal quantities of certain substances which pass through the organism without causing in it the least change can provoke such disordered chemical actions as to occasion death? How are we to understand the fact that different parts of the organism seem to be able to distinguish these substances, the one from the other? We must admit special elective functions proper to the life of the cells. How are we to understand the facts that nothing but a change in the quantity of their dosage, the duration of their administration, and the method of their application suffices to make of certain toxic substances stimulants or paralysants? How are we to understand the fact that insoluble substances like arsenic, cannabis indica, and lead can defy that well known axiom, *Corpora non agunt nisi soluta*, and manifest therapeutic and toxic action? We must admit the presence and agency of some unknown power within the living cell. How, again, are we to understand the therapeutic power exhibited by solutions of iodine and bromine which have apparently been diluted to the deprivation of all chemical action, unless we attribute to the living cell the power of liberating the iodine and the bromine from such dilute solutions? Thanks to my compatriot and dear colleague at the University of Amsterdam, Professor Van t'Hoff, thanks to the admirable work of Arrhenius and of Ostwald, thanks to congresses of physicians and chemists, light seems to me to be about to be shed upon all these dark places in pharmaco-therapeutics. And it has not been Mahomet who has gone to the mountain, but the mountains which have come to him. In other words, the study of the chemical affinities of dead matter has revealed to us the secrets of the living cell.

THE APPEARANCE OF "VITAL PHENOMENA" IN CERTAIN CHEMICAL SOLUTIONS.

We have been accustomed to regard the neutral solution of sugar or of some neutral alkaline salt in water as an inert liquid deprived of all molecular power. We know to-day that such a solution must be held to possess the same kinetic power as if the substance dissolved were present in the gaseous state. Placed in contact with other solutions it will exercise pressure according to the laws that Avagrado and Dalton have discovered for gas. It will exercise an osmotic pressure in direct proportion to its molecular weights. But this is not all. We have to remember the electrolytic phenomena of such solutions by which their kinetic power may be rendered enormous. This conception of the molecular properties of solutions is of the highest importance both in biology and pharmaco-therapeutics. It is not by accident that life is so closely leagued, as it were, to water. It is not by accident that living organisms contain without exception more water than solid properties, that they contain much more of it in proportion than any other terrestrial object of palpable and visible formation. It is not by accident that the youngest and most energetic organisms, those in which life is the most intense, are distinguished by containing the most water, while the tissues in which life is ready to expire have the least. Life has been compared to a torch. From a chemical point of view life is not only a torch—it may also be compared to a river. It is an ocean in which the molecules of the chemical substances there constantly dissolve, constantly develop chemical, electrical, thermal and mechanical energy, an energy whose seat is the living cell.

From all of this it follows as an absolute necessity that the chemical actions which constitute vital phenomena become stimulated, troubled, or altogether upset from the moment that we introduce into the system some new complicated substances in solution, whose molecular forces are now added to those of the cellular system. We are only embarrassed what example to choose when we seek in organic and inorganic chemistries proof of this point. I only wish to name one to you which seems to me conclusive. By warming pure chlorate of potassium we obtain pure oxygen, but the presence of the smallest quantity of chloride of potassium is sufficient to change part of oxygen into ozone. In giving rise to this development of ozone the chloride of potassium remains itself completely unaltered; but, what is more remarkable yet, this chloride of potassium itself has, like peroxide of manganese—which acts in an identical manner—the property of destroying ozone.

We find, then, here, as M. Brunck, to whom belongs the honor of having discovered the reactions, has said, a most remarkable phenomenon. We see a chemical substance, without itself appearing to undergo the least appreciable molecular change, favors the formation of a new chemical body, which, on the other hand, it has the power to destroy the moment that it is formed. There is, in fact, in the domain of organic chemistry, with no question of fermentation, a catalytic force, in considering which we have to make for dead nature a complete pendant of that which we should scarcely consider characteristic for therapeutic actions—the phenomena of excitement and paralysis, manifested by the slightest possible quantities of one and the same substance which itself remains unaltered! And speaking always with these phenomena before our eyes, and looking on the cell as a colloid or membraneous mass containing several substances, organic and inorganic, at the same time dissolved in water, there is no longer any reason to be astonished that slight changes in the quantity of one substance or the other, or that the presence in one of a body that is absent in the other, suffice perfectly to change the chemical affinity of the cells, as well as to differentiate them in such a manner that each of them seems to be endowed with an elective affinity peculiar to itself. As for the manifestation of therapeutic and toxic action by bodies considered to be insoluble, of which Nageli in a posthumous work has made so profound a study, they are also capable of the simplest interpretation. The insolubility of these bodies is not absolute, but only relative. If we throw, for example, metallic copper into water, and wait for some days, we shall find that a certain proportion of the copper has dissolved, *i. e.*, one part to seventy-seven million parts of water. The copper dissolves in this manner without the least intervention of any living organism. In the same way it is not the vital function of the human organism which makes arsenic, cannabis indica, and lead display active properties when introduced in a metallic state under the skin. It is the mass of water which is the agent (for the human body may be regarded as a jug of water containing forty-five liters) and the temperature.

The view that regards the solutions of salts as mediums in which the chemical molecules are perpetually striving to assert their individuality has contributed, on the other hand, in the most efficacious manner to elucidate the action of some of the drugs that are most in use. I have particularly in my eye now the purgative and diuretic salts, the chlorates, iodides and bromides, whose therapeutic effects are obtained upon doses that may be called massive when comparing them with the infinitesimal doses of which we have just spoken. Since my dear and honored colleague of the University of Amsterdam, Prof. Hugo de Vries, discovered the law of iso-tonic solutions, and since the admirable work of Prof. Hofmeister, of Prague, and his pupils, the effects of purgative and diuretic salts have been recognized to depend uniquely upon their pure chemico-physical properties. On the other hand, we owe to the zeal and perseverance of Prof. Hofmeister, of Prague, again a series of very beautiful researches on the imbibition of salt solutions by tablets of pure agar-agar gelatine, which demonstrate to proof that all that we have hitherto considered the elective affinity of the living cell can be explained in the most natural manner in the world by its colloid condition and chemical constitution. Add to this that the quickness of chemical action, according to the interesting chemical researches of Vladinarsky, is in no way impaired by the colloid state of the medium in which the substances are placed, and you will easily arrive at a conception of the immense progress that pharmaco-therapeutics has made by the agency of physical chemistry. Among the salts that I have named, the iodides and bromides are also to be found. Their therapeutic effects are, I need not say, altogether specific. What is more natural than the belief that we ought to attribute the results to the iodine and bromine themselves; and we all know that some long time ago, my colleague at the University of Bonn, Prof. Binz, has been able to demonstrate that it is the living cell which frees the iodine and bromide from solution. The fact is not, however, proved to universal satisfaction.

I should never finish my task if I tried to place before you all the points of the new view on the action of drugs, poisonous and otherwise, whose pharmaco-therapeutics are traceable to the theories of modern chemistry. Let us glance only at the catalytic fermentative actions which take place everywhere in live protoplasm, and which without doubt play a preponderating role in the therapeutic effects of drugs. These can no longer be considered the appanage of the living cell. They also take place in dead matter.

CHEMISTRY IN RELATION TO MATERIA MEDICA.

If I now stop theorizing, it is not from fear lest any one in this Areopagus of science should say: To what practical good does all this tend? Evidently it is not to-day or to-morrow that the art of medicine will profit by chemistry. But all these new ideas have rendered necessary new methods of experimentation and new methods of investigation; and a new track is now being traced by human genius, along which there is much to discover; and from the moment that the new physical methods shall have been applied to the study of drugs (all honor to M. Dreser, who has here taken the initiative in his investigation into diuresis) medical art will profit and will find in chemistry a sure and trusty guide in its efforts to serve humanity.

In speaking of chemistry in its relation to materia medica I do not employ the words materia medica in the sense in which Discorides used them. I employ them in their strictest and primitive sense to mean the collection of drugs and medicaments in use in our days—our *thesaurus medicaminum.* Materia medica recruits from botany, zoology, and above all from chemistry; but its immense progress of late is due to chemistry. The active principles of almost all our drugs are now known to us. They have been isolated, prepared and elaborated; the chemical constitution of their active principles is no longer a secret.

* An address delivered at the Eleventh International Medical Congress, at Rome, 1894; from the *Lancet*.

* It must be remembered that all of this is qualified by Professor Stokvis' original reservation, "Once given that the creature lives."

We know that sugar and glucosides and aromatic oils belong to chemical groups, and are as well defined as the alkaloids derived from pyridine or chinoline. Every day the number of contumelious substances—substances which do not wish to reveal to us their secrets—grows less. Chemistry has revealed to us the presence of more than twenty alkaloids in opium, and of more than six in quinine; and it will soon be extremely difficult to name the drug, of animal or vegetable origin, in which there have not been found one or several active principles. And, going from victory to victory, chemistry has also succeeded in producing a great number of alkaloids by the synthetic manner. These have not been the exceptional lucky strokes (*coups de maitre exceptionels*). No constitution and composition of other bodies that chemistry has not yet reproduced for us is already familiar to the chemist who can transform morphia into codeia and *vice versa*, and worthless cupreine into effective quinine. We may predict with every confidence that the manufacture by synthesis of all the known alkaloids is only a question of time for chemistry. But the triumphal march of chemistry does not stop here; it has constructed for us new alkaloids endowed with therapeutic effects of great value. It has furnished us, *inter alia*, with apomorphine and apocolaine.

It would be unequaled ingratitude to fail to recognize the imperishable services that chemistry has rendered to materia medica in endowing it with the alkaloids and the pure active principles because there are a few black clouds on the horizon. That there are such I do not deny, but they are not wholly the fault of chemistry. Is the gunsmith responsible for the accidents that a new firearm may cause in the hands of a client who does not know how to use the weapon properly? Surely not. Why did not the purchaser take the trouble to understand the structure of the gun? Why was he not more careful? Why did he pay no attention to warnings? Why did he behave like a happy child, with nothing more important to do than to display his new acquisition to all the world and to put it to the test with the innocence of youth? On the other hand, should not the gunsmith help to avoid such disasters by explaining matters to the purchaser? And if he is not himself sufficiently informed and does not thoroughly understand the mechanism of the weapon, should he have offered it for sale? Either party may be to blame. What I want to convey by my parable is this: by a very pardonable illusion, to which the many physicians and some chemists have given way, it has become generally believed that the active principles of drugs, when chemistry can furnish them for us in a crystallized state, are purely chemical bodies, and that identity of name guarantees identity of chemical composition. This illusion is rapidly being dispelled, but, alas! not without having done harm to physicians and their patients. As far as the chemical purity of crystalline products is concerned, it is to-day a secret of Polichinello that crystallized quinine contains cinchonidine, that atropine contains hyoscyanine and atropamine, and that pilocarpine contains jaborandi. As much in organic as in inorganic chemistry we come across this phenomenon of mixed crystallization. The crystallization of substances is no guarantee of their chemical purity. These facts are sufficient to condemn entirely the new therapeutic system that M. Burggraeve has wished to inaugurate under the name of "dosimetric medicine." Dosimetric medicine is doubly on the wrong track—first, in assuming the chemical purity of active crystallized principle of which it exclusively makes use, and secondly, in enunciating the therapeutic heresy that the administration of a single active principle is worth much more than the administration of the drug from which the active principle has been derived. I do not hesitate to describe this dosimetric profession of faith as a heresy. The drugs that are most used are admirably made compositions in which different principles, working for or against each other, are found together. Their therapeutic effect on the system is altogether different from the effect that would be obtained by adding and subtracting the therapeutic effects of each ingredient. Recent pharmaceutic researches have conclusively demonstrated this fact. I do not wish to say too much against domestic medicine. I think it has been, on the whole, inoffensive. Alas! I cannot say as much of the unreasonable faith which leads persons to believe that similarity of name and of active principle in crystalline form will produce chemical and pharmaceutical identity. *Ingentem, regina, jubes renovare dolorem!* We all know the grievous results that may be caused by giving aconitine or digitalin derived from different sources. Here again the progress of chemistry promises improvement. The animal organism is most sensitive to stimulus, and modern chemistry has so many methods of stimulus at its disposal that the task will not be too arduous. It is a question which interests all civilized countries, which is brought forward at all medical and pharmaceutical international congresses, and which is in most urgent need of a satisfactory solution.

THE VAGARIES OF MODERN PHARMACY.

The services rendered by chemistry to therapeutics is not an exhausted subject. Certainly our predecessors already possessed a goodly medicinal treasury, but it seems very insignificant when compared with what we now utilize. Chemistry has loaded materia medica and pharmacology with wealth; it is the mother of new remedies, and we are proud of its aid; it has given us our anæsthetics, antiseptics, hypnotics, and antipyretics. These groups of remedies enable us to give relief in many cases where our forefathers were quite helpless. To them chloroform, ether, carbolic acid, iodoform, creosote, chloral, the salicylates, antipyrin, were all alike unknown. But here, again, and more so than with respect to the alkaloids, there are shades in the picture.

Chemists and chemical manufacturers add more and more to our store of remedies day by day without stint or truce, without heeding the great despairing physician already overstocked with drugs. We are tempted to cry out for mercy. This is no exaggeration, for these new chemical products are all forced upon the same therapeutic market under the most attractive names, and all proclaimed aloud with the noise of the most perfect advertising machinery. This is now done to an extent that, in my opinion, is detrimental to the interests of therapeutics. I am not speaking of quack remedies, the ovietara of our day, of those secret specifics which the medical man views with wholesome horror, to which, and to whose use, the old adage, *Trompeurs, trompés, trompettes*, can be so well applied. I am speaking of genuine well-known products; for, unfortunately, modern and industrial chemistry, in manufacturing and in placing at the disposal of doctors these drugs, does not at all object to their being purchased by the general public. If this is not so, why do their proprietors select for their names the fascinating names that act as veritable flags to attract the public—for instance, anti-nervine, anti-phthisine, anti-rheumatic, anti-dysenterine, and most expressive of all, migrainine. I fully appreciate the difficulty of finding new names for these new products, and can understand that the manufacturer should shrink from giving them the names derived from their chemical composition, for these, generally speaking, could only be pronounced with linguistic gymnastics and intolerable strain upon our memory. I must, with great regret, note that we have departed from the ancient method, which taught us to denominate new products according to their origin, and we have followed freely a course that I cannot blame too severely—that of seeking for euphonious, sonorous names, pompously proclaiming the therapeutic use and effect of the drugs designated by them.

It is not sufficient nowadays to have a good remedy—say agathine—we must be assured of its superlative excellence, hence aristol. Do you want to prescribe for a patient who is "out of sorts," you have euphorine; for a lack of appetite, you have orexine. You desire to procure sleep for him: you have hypnal, hypnon, somnal, or somniferine. You wish to lower a febrile temperature: do not let the emergency trouble you, for you have antipyrine, antifebrine, antithermine, thermomine, thermofugine, pyrodine, and thermodine. You want to assuage pain? *Eh bien*, you have awaiting your orders analgesine, analgeine, exalgine, exodyne, and neurodyne. Or you desire to stimulate urinary secretions, you have diuretine, pheduretine, and uropheime. To check the formation of pus there is a remedy termed pyoktonine; and to combat spasms antispasmine. I do not wish to exhaust your patience and I will spare you the enumeration of the antiseptics, the disinfectants, the microbidines *e tutti quanto*. Ten years exactly have elapsed since my honored colleague, Prof. Rossbach, of Jena, published an article full of wit and sound sense in ridicule and blame of these tendencies of modern therapeutics, and in those days we had not the long lists of antiseptic and antipyretic remedies. Nor was it then imagined that the essential extracts of the organs of animals, of which the late Prof. Brown-Sequard and M. C Paul were the earliest to explain the therapeutic value, would find a place in materia medica, nor cultures of microbes. It was not foreseen that we should have to chronicle in 1894 the sale not only of sequardine, but also of veritable bacterial products such as tuberculine, tuberculocidine, antituberculine, antitoxine, *x.r.λ.* How shall we check the fury of this flood? There seems no reason why it should ever come to an end.

CHEMICAL NOTES.

FROM *Nature* we learn that a series of compounds of sugars with mercaptans, the sulphur alcohols, of a nature similar in many respects to that of the recently isolated glucosides formed by the combination of ordinary alcohols with the sugars, are described by Prof. Emil Fischer in the current *Berichte*. These new substances differ from the glucosides of the alcohols in their constitution, however, for they contain two equivalents of the sulphur alcohol to one equivalent of the sugar; hence they are more nearly allied to the similarly constituted compounds of mercaptans with ordinary aldehydes. The members of the series fully described are the ethyl mercaptals of grape sugar and of galactose, and the amyl mercaptal of the former. In addition to these Prof. Fischer has isolated the ethyl mercaptals of mannose, arabinose, rhamnose and *a*-glucoheptose, and has qualitatively proved the generality of the reaction for xylose, maltose and milk sugar. The compounds appear likely to prove of very great importance, for their formation occurs so readily that they will serve admirably in many cases as valuable aids in the identification and isolation of either the well-known or newly-discovered sugars. The amyl compound in particular appears likely to be of great service on account of its slight solubility. They are all substances of considerable stability and crystallize well. Glucose ethyl mercaptal, $C_6H_{12}O_5(SC_2H_5)_2$, is prepared by mixing ethyl mercaptan with an ice-cold solution of grape sugar in fuming hydrochloric acid. Upon cooling, after the slight rise of temperature which accompanies the reaction, crystals of the new compound separate, and may be advantageously recrystallized from absolute alcohol. The reaction is simply an addition of two molecules of the mercaptan to one of glucose with elimination of a molecule of water.

$$C_6H_{12}O_6 + 2C_2H_5SH = C_6H_{12}O_5(SC_2H_5)_2 + H_2O.$$

Glucose ethyl mercaptal crystallizes in colorless needles and plates, which possess a taste very different to that of sugar, being disagreeably bitter. The crystals melt at 127°, and the liquid may be partially distilled at a higher temperature. The substance is only slightly soluble in cold water and the solution is lævo-rotatory. It behaves as a weak acid, and it is somewhat remarkable that alkalies dissolve the crystals in large quantity, and upon the addition of a dilute acid the compound is precipitated. Indeed, the sodium salt, $C_{13}H_{21}S_2O_5Na$, has been isolated in well defined crystals by treating the compound with sodium dissolved in methyl alcohol. That the substance is very different in its nature from the original glucose is further evidenced by the fact that it does not reduce Fehling's solution. The other members of the series appear to be characterized by similar but graduated properties, the solubility, for instance, diminishing as the homologous series of mercaptans is ascended.

Chloraurate of silver, $AgAuCl_4$, an interesting compound of the very soluble and deliquescent chloride of gold with the particularly insoluble chloride of silver, is described by Dr. Hermann, of Aschaffenburg, in the same number of the *Berichte*. This compound has formed the object of previous unsuccessful researches, but its preparation is very simple when the necessary conditions are known. Four parts by weight of metallic gold are dissolved in aqua regia, and the solution evaporated over the water bath, until upon cooling the resulting chlorauric acid, $HAuCl_4$, crystallizes. One part by weight of silver dissolved in dilute nitric acid is then added, when silver chloride is precipitated in its usual form. Upon repeated evaporation of the whole with concentrated nitric acid containing a trace of hydrochloric acid the silver chloride changes, becoming colored bright red, and eventually is completely converted into a mass of crystals of silver chloraurate. The crystals are long prisms terminated by pyramids and dome faces; they appear to be colored bright orange red when singly examined by reflected light, but are pure yellow by transmitted light, and the finely powdered substance reflects bright yellow light. It is interesting to note that when inclosed in a sealed tube containing perfectly dry air the compound is quite stable and unaffected by bright sunlight, but the moment it is exposed to sunshine in ordinary moist air it commences to bronze, and eventually becomes superficially coated with a dark bronze metallic coating. Dilute hydrochloric acid instantly decomposes it with formation of silver chloride and a solution of chlorauric acid. Ammonia, on the other hand, decomposes it with production of the usual ammoniacal solution of silver chloride and deposition of fulminating gold.

ANAMORPHOSES.

OUR readers are assuredly acquainted with the silvered cylinders sold by opticians and that permit, through reflection, of rectifying the distorted figures

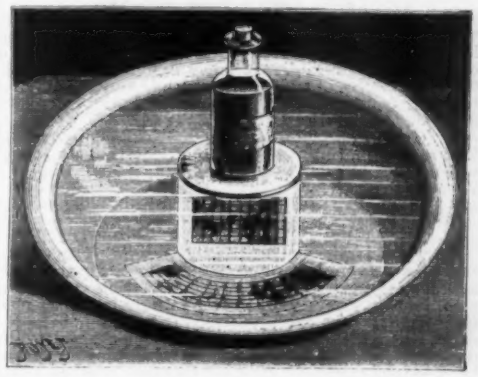


FIG. 1.—EXPERIMENT IN ANAMORPHOSIS.

known by the name of anamorphoses. The effects of total reflection may be observed by immersing an inverted glass vessel in water, and a method of obtaining anamorphic images may thus be secured.

Fig. 1 shows the arrangement adopted by Prof. Thomas Estriche, of the Institute of Barcelona. A glass vessel very dry in the interior is inverted in a large bowl with a wide bottom. In order to keep the vessel at the bottom of the bowl, a weight is placed upon it, a bottle, for example, if there is no other object at hand. We thus obtain an anamorphic mirror. The glass vessel appears flattened through the effect of refraction. When it is desired to make use of the glass as a mirror of anamorphosis, figures are placed

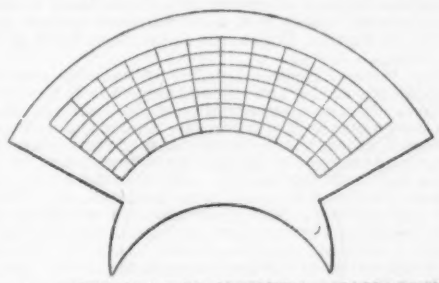


FIG. 2.—OUTLINE FOR MAKING ANAMORPHIC DRAWINGS.

at the bottom of the bowl. As these figures are immersed in water, the paper upon which they are drawn must be rendered impermeable. This is easily done with varnish, or the figures may be painted in oil upon canvas.

Fig. 2 gives the outline that serves for making the anamorphic drawing. If one does not desire to immerse the drawings or paintings in water, he can substitute a large flat-bottomed glass vessel for the bowl. The drawings may be placed under this vessel. They are dry upon the table upon which one operates, and they are observed by transparency through the glass. —*La Nature.*

TEMPERATURE OF VISIBILITY.

AT a recent meeting of the Physical Society, London, Mr. P. L. Gray, B.Sc., A.R.C.S., read a paper "*On the Minimum Temperature of Visibility*," describing experiments made to find the lowest temperature at which bright or blackened platinum becomes visible in the dark. The instrument used was a Wilson and Gray's modification of Joly's meldometer, in which a thin strip of platinum about 10 centimeters long and 1 centimeter wide is heated by an electric current. The expansion of the strip is indicated by an optical method, and is used for estimating the temperature of the strip. To calibrate the arrangement, small particles of substances having known melting points were placed on the strip and observed through a microscope, the position of the spot of light showing the expansion being noted when the substance melted. The general conclusions arrived at are:

1. That the minimum temperature of visibility is the

same for a bright polished surface as for one covered with lamp black, although the intensity of radiation in the two cases may be different.

2. That the visible limit at the red end of the spectrum varies greatly for a normal eye, according to its state of preparation Exposure to bright light diminishes the sensitiveness of the eye, and darkness increases it.

3. That for the less sensitive condition the minimum temperature of visibility for the surface of a solid is about 470 deg. Cent., but this may be much reduced by even a few minutes in a dark room.

4. That at night a surface at 410 deg. Cent. is visible, and that by resting the eyes in complete darkness this may be reduced to 370 deg. nearly.

5. That different people's eyes differ somewhat in their "minimum temperature of visibility," but probably not to any great extent, if tested under the same conditions as to preparation, etc.

To most observers the strip at these low temperatures had no appearance of red, but looked like a whitish mist. Inserting a plate of glass or a layer of water in the line of vision had no effect on the temperature of visibility.

Mr. Blakesley inquired if the author had tried condensing the light from the strip. As to colorlessness, he observed that the parts of the retina active in oblique vision were less sensitive to color than the central portions.

Dr. Burton remarked that in the experiments the presence of light, and not color, was being observed. When illumination was faint, as in twilight or moonlight, it was very difficult to distinguish colors. In the solar spectrum one did not see any whitish termination at the red end.

Mr. Elder said Captain Abney had shown that all colors appear gray when of small intensity.

The president thought the question as to whether visibility depends on wave length or on energy was an important one. Probably a minimum amount of energy was essential. At such low temperature the emission curves of the different wave lengths may not have become sufficiently separated to be distinguished.

Mr. Gray, in reply, said Professor Langley had shown that a minimum, but very small, amount of energy was necessary to vision in all parts of the spectrum.

PROBLEMS OF LIGHTING.*

THE eye perceives lights of peculiarly different intensities. With my photometer, founded upon the law of the luminous loss of phosphorescent sulphide of zinc, I have recently determined the least amount of light that the eye can perceive. It is 29 billionths of a candle at a distance of one meter or one candle at a distance of 5·872 kilometers. It is a value comprised between the numbers obtained by other observers with other methods. If it be admitted that the brilliancy of the sun is fifty thousand times that of a candle at one meter, and if the minimum perceptible brilliancy be taken as a unit, it will be seen that the eye is capable of comparing lights varying between about one and one trillion.

The eye is not always capable of looking at the sun with impunity. Plateau was rendered blind by directing his eyes at it fixedly.

For some years past brilliant lighting has been the fashion, and, for the last century, lighting has followed a continuous progression. The mirror hall of the palace of Versailles, which, in 1745, received but 0·19 of a candle per cubic meter, received, in 1873, 0·43 of a candle, and, in 1878, 0·85. It would seem as if there were here an indication of that evolution of the sensitiveness to strong sensations that we find in other domains —the auditory sensation, for example. We know that for a century past all tuning forks have been tending to the sharp, and it is in order to react against such tendency that in France the *la* has been fixed at 870 vibrations.

The intense electric lighting of railway stations, large stores, etc., is not without danger to the nervous system. It causes a weakening of the hearing, insomnia, and digestive disturbances. Under the influence of such lighting, headaches, dimness of vision, paralysis and anæsthesia of the left side have been found in nervous and arthritic persons. An insufficient lighting causes dilation of the pupil, hyperæsthesia, etc. There is a just medium. The illumination of a well exposed surface effected by ordinary daylight is estimated at 50 candles at a distance of one meter. In order to read and write without fatigue, there is required a light of at least 10 candles at one meter.

The following are a few mean lightings that merit comparison:

BOUGIE METER.

Rue Royale	1·28	=1	candle	at 0·89	meter.
Rue de la Paix	1·20	=1	"	" 0·91	"
Place de l'Opera	0·559	=1	"	" 1·34	"
Avenue de l'Opera	0·344	=1	"	" 1·70	"
Rue du Quatre Septembre	0·344	=1	"	" 1·70	"
Boulevard St. Jacques	0·235	=1	"	" 2·08	"
Jardins de l'Observatoire	0·013	=1	"	" 8·77	"
Full moon in Sologne	0·372	=1	"	" 1·93	"
Diffused light of the stars	0·00057	=1	"	" 41	"

I calculated the first five numbers by converting into ordinary bougies meter (¼ carcel meter) the numbers estimated in *lux* ($\frac{1}{10}$ carcel meter), which Mr. Palaz indicates in his *Traité de Photometrie Industrielle*. They are due to the engineers of the Parisian Gas Company and relate to lighting by gas. They were obtained with the Mascart photometer, while the last four were obtained with my photometer, especially designed for the measurement of feeble lights.

In Mascart's photometer, a general view of which is given in Fig. 1 (No. 2), the light is received upon a Foucault screen, E (Fig. 1, No. 1), of fine paper, and is then reflected by a mirror, M, inclined at an angle of 45°. The whole is mounted upon a horizontal tube, T, and the screw is capable of turning in all directions. At L there is a movable diaphragm against which is placed a lens, F, situated at a distance from the screen double that of its principal focal distance, and which produces an image of the first screen, E, upon a second screen placed behind the total reflection prism, P, and upon the passage of the luminous pencil at the extremity of the large tube, T. The Pigeon kerosene lamp, S, the height of whose flame is regulated by projecting it upon a piece of ground glass, *e*, provided with reference marks, sends upon the Foucault screen, E', a pencil of light concentrated by a lens. This pencil afterward traverses the second movable diaphragm, L, and then the lens, F', and is reflected by the mirror, M', and the prism, P, upon the second half of the screen at the extremity of the large tube, T. A lens, O, allows this screen to be distinctly seen, and a diaphragm, R, composed of colored glasses, permits of equalizing the tints to be compared.

The diaphragms are opened and closed at will by means of buttons placed at the exterior and beneath the tubes. We know from a theorem, often applied since the time of Bouguer, that if, with a converging lens, we form a real image of a luminous source and

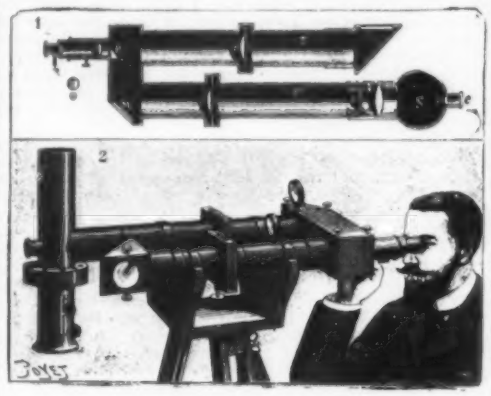


FIG. 1.—MASCART'S PHOTOMETER.
1. Section of the apparatus. 2. General view.

cause the aperture of the objective to vary by a diaphragm, the illumination of the image will be proportional to the surface of opening of the diaphragm, provided such opening be always very small with respect to its distance from the luminous source.

Let us suppose that the receiving screen be lighted by a carcel lamp at one meter. In order to have two identical lights at O, it will be necessary to open the two diaphragms by a certain number of divisions. These latter are read at the exterior by means of two lenses without the eye leaving the plane of observation. Let N' be the number of divisions on the side toward the lamp of comparison, and N the number of divisions on the side toward the receiving screen of the light of one carcel at one meter; the relation $n_0 = \frac{N'}{N}$ will be a constant of the apparatus to be determined once for all. In another experiment, with another illumination, we shall have another N', say N'_1; whence another relation, $n_1 = \frac{N'_1}{N}$. The quotient $\frac{n_1}{n_0}$ gives the value of the illumination in carcels meter in the second experiment.

It is evident that with a view to the measurement of very brilliant lights, we can take a light of a much greater intensity than one carcel as a unit. It suffices to render the receiving screen, E, more opaque and the screen, E', less so. For the measurement of feebler lightings, the screen, E, would be rendered more translucent, and the screen, E', would be made more opaque.

Nevertheless, for very small openings of the receiving screen, the error committed in the reading of the graduation, and which is expressed by a fraction of a millimeter sensibly always the same, represents a necessarily large fraction of the quantity measured. There is here, imposed by principle, a limit of precision that it is impossible to surmount. This is why I have had constructed, especially in view of very feeble lights, a photometer founded upon the law of luminous loss with time, of phosphorescent sulphide of zinc.

FIG. 2.—HENRY'S PHOTOMETER.
1. Method of using the apparatus. 2, 3, and 4. Explanatory figures.

This very simple apparatus (Fig. 2, Nos. 1 and 2) consists of three connected tubes blackened internally. The one that is applied to the eye is provided with a converging lens, A, of great focal distance, the object of which is to suppress the sides of the tube from the field of distinct vision. This tube slides within another provided with two ellipsoid slits, one at the top and the other at the bottom.

A magnesium ribbon 0·003 meter in width, about 0·13 meter in length and 0·0001 meter in thickness, suspended from an arm, H, is designed to burn in this space isolated from the interior of the apparatus by two protecting glasses, B and G. These dimensions of the ribbon suffice to give the sulphide a maximum illumination.

Upon this central tube is screwed externally a tube terminating in two semicircular screens, E and F (Fig. 2, No. 4), separated by a perpendicular partition. One of them, composed of ground glasses of a greenish yellow color identical with the phosphorescent tint, and for which, in view of very feeble intensities, there may be substituted any less absorbent screen through the simple play of a ring, receives the external light. The other is covered with sulphide of zinc.

The posterior tube is separated from the front one, the magnesium ribbon is lighted and the time at the moment of extinction is noted. The posterior tube is replaced against the anterior one, and the time is noted at which there is an equality in the light of the two screens.

On giving the value 100 to the light of the sulphide at the end of 85 seconds—a light equal to the illumination of the translucent screen by one candle at 3·75 meters—there have been found for the lights, at the different times, values that are the ordinates of the curve shown in Fig. 3. Knowing with all precision possible the time at the end of which there is an equality of light between the phosphorescent screen and the translucent one, we take the corresponding ordinate upon the curve of the observations at the time indicated by the chronometer and marked upon the abscissa. This is referred to any ordinate whatever expressed in bougie meter, and we immediately have the brightness of the source in fractions of bougie meter. It is in this way that I have been able to measure the light of the full moon, and of the points of the sky opposite the moon, etc.

For more precision in the measurement of feeble lights it is well to make use of a curve constructed upon a large scale.

The greenish color of the sulphide, far from being prejudicial to the precision of the observations, contributes much to it, since, according to a well-known law, as the phosphorescent screen is less luminous than the translucent one, it appears bluish, and the other yellowish.

For the equalities of tints that are produced before 1,400 seconds, the curve of the observations is immediately utilizable. For the feebler lights the most convenient way to proceed is to apply one of those formulas called asymptotic, that reproduces as faithfully as possible the last observations, and consequently offers a guarantee of being true much farther.

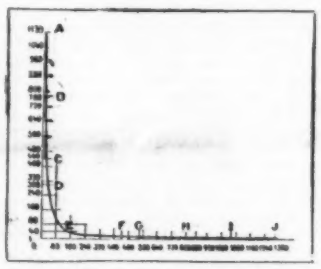


FIG. 3.—CURVE OF LUMINOUS LOSS OF PHOSPHORESCENT SULPHIDE OF ZINC.

It is by the extrapolation of this formula warranted by considerations of mathematical physics that I determined the diffused light of the stars on August 22, 1892 (0·0005704 bgm.) and the minimum of luminous intensity perceptible.

This apparatus may be used also, thanks to a few very simple complementary arrangements, for measuring the absorption of chemical rays by liquids, fluorescence, the richness of light in chemical rays, etc.

For the purposes of photoptometry (measurement of luminous sensitiveness) I have had constructed, by Mr. Rodiguet, a photometer founded like that of Mr. Mascart upon the principle of the diaphragming of objectives, and the luminous source of which is a screen covered with phosphorescent sulphide of zinc. This apparatus gives very rapidly, and with a precision impossible to obtain with ordinary lights, the minimum perceptible.

Just as there are consonances and dissonances, just so there are juxtapositions of luminous intensity that aid or injure the eye, and that produce relative anæsthesias or hyperæsthesias of the retina. Such modifications of the nervous system can be explored by varied methods and be characterized by numbers. The object of all sumptuous lighting is to create harmonies of light. This result, which would be so urgent to realize in ordinary lighting, is not, as a general thing, reached. The eye is always injured in drawing rooms and in the great, fashionable halls by the multiple reflections of the dazzling whites and of the gildings, or by the incoherence of the arrangement of the usually identical sources of intensities. People content themselves with recalcitrating, and forget that for strong excitations our sensitiveness varies much less quickly than does luminous intensity.

It is not very convenient to experiment upon a large number of mean luminous intensities in given ratios. Such experiments are costly and cumbersome, but it is easy to realize harmonies of lights and to verify the law of them with feeble intensities like those given by phosphorescent sulphide of zinc.

It suffices to operate upon layers of unequal thicknesses, like those that I have obtained by a typographical impression in my *Lavis Lumineux*, or upon layers of the same thickness that are illuminated at different instants calculated in advance. The sulphide of zinc permits of managing the light with as much facility as the printer or the painter manages any sort of pigment.

Physiologists have long observed that a certain time is necessary and sufficient for the integral perception of a light. Such time is shorter when the intensity is greater. What is such duration when the intensity is the least that is perceptible, like that of the light of a

* Continued from SUPPLEMENT No. 961, p. 15366.

beacon at the limit of its luminous range? It may be estimated at $\frac{1}{10}$ of a second. This observation has led to a remarkable innovation in the lighting of our beacons. For the apparatus making an entire revolution in eight minutes and giving flashes of a duration of eight seconds there are substituted optical apparatus of two lenses, at the most, making a revolution in five or ten seconds and giving flashes of a tenth of a second. It has thus been possible to greatly increase the power of the lights, and attain intensities of twenty-three million candles without augmentation of expenses and without an addition of motive power.

There are no problems more varied, more complex, more practical, and more happily treated in recent times than those of lighting.—*Charles Henry, in La Nature.*

HINTS ON COLORING LANTERN SLIDES.

By GEO. M. HOPKINS.

IT frequently happens that one who is practiced in the art of coloring lantern slides desires to color a rare or valuable slide when the remotest chance of injury to the slide cannot be taken. In such cases the color must be applied either to the back or outer surface of the plate or to a plate that will answer the purpose of a cover glass. The latter method is certainly to be preferred, as it involves no risk whatever, and at the same time affords an opportunity of trying different color effects on the same picture; such for example as spring, summer and autumn tints in landscapes, and different combinations of color in architectural views, interiors or figures.

The plate used for receiving the color is an old unused gelatin lantern slide plate, from the film of which the silver has been removed by hypo; or a gelatin plate from which a discarded view has been removed from the film by means of a reducing solution; the plate in either case being washed long enough to remove all hypo.

The film on the unused plate will need toughening by soaking it for two or three minutes in a solution of alum of the strength commonly used for preventing frilling, the plate being afterward thoroughly washed. This plate takes color better than one which has been subjected to the reducing process. A plate may also be prepared by flowing a solution of gelatin over a clean cover glass, allowing it to dry, and then treating it to an alum bath and subsequent washing.

The slide to be colored, which is, of course, unmounted, is placed with its glass side against the glass side of the transparent film-bearing plate, which is dry, and the transparent film is wet all over by means of a very soft brush carrying clean water. Some caution is required to prevent the film side of the slide from becoming wet. A small quantity of water absorbed between the contacting glass surfaces is an advantage, as it binds the plates together and prevents them from moving easily one on the other.

The coloring is done upon the transparent film, following the outlines and every feature of the picture as closely as possible. It will, of course, be impossible to follow every leaf and blade of grass, or every twig and flower, with perfect accuracy, on account of two thicknesses of glass intervening between the color film and picture film, yet the results secured by this method are astonishing. The writer has colored slides in this way which were not distinguishable, even by experts, from slides colored on the picture-bearing film. The following description of a method of coloring prints on gelatin-coated lantern slide plates is taken from the writer's article in the SCIENTIFIC AMERICAN of March 11, 1893, it being applicable in the present case:

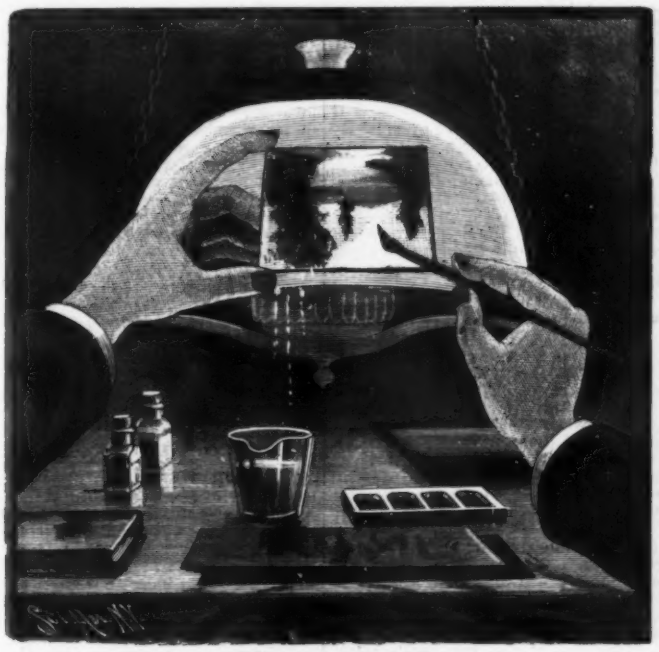
The first operation in coloring is to go over the entire surface of the film while it is wet with a thin wash of warm color, which may be either yellow or pink, depending upon the subject. This kills the chalky whiteness of the high lights, and gives the entire picture a warm and desirable tone, even though the wash is not sufficiently strong to be detected when the picture is thrown upon the screen.

The colors used for this purpose are transparent aniline colors prepared for coloring photographs. They are labeled brown, blue, violet, flesh, orange, green, and so on. The ordinary aniline dyes may be used instead of the prepared colors, as they are practically the same. The manipulation of the colors is the same as in water color painting. The film is kept wet continually from the beginning to the end of the operation, but after the broad washes of the first warm tint and the final sky color, the water lying on the surface of the film is allowed to dry off, leaving the film still swelled and wet, but without the surface water.

The prepared colors can rarely be applied to the slide without being reduced with water. Sometimes the best effects are produced by mixing different colors before applying them, while in other cases the effects are secured by separate washes of different colors, superposed. Each wash of color sinks into the film and is not removed by a subsequent wash.

Although an easel or support something like a retouching frame may be useful, the writer prefers to hold the slide in the hand, as shown in the engraving. The wet plate is held in a slightly inclined position in front of a lamp provided with a plain opal or ground glass shade. The writer prefers artificial light for coloring, as the pictures are to be shown generally by artificial light, which is yellow. If the pictures are designed for projection by sunlight, it is undoubtedly better to color them in daylight.

The first wash is preferably put on while the slide is held in an inverted position, and while it is still flowing the blue is added for the sky, at first very light near the horizon, increasing in intensity toward the top of the slide. After this wash is set and superfluous water has evaporated, the water accumulating along the lower edge of the plate is removed with the fingers, and the slide is turned right side up, when the extreme distance, whether it be mountain or foliage, is covered with a light wash of blue, and this wash is brought well down toward the foreground. If the blue appears cold, it can be toned down by a very light wash of yellow or red. Trees in the middle distance can now be gone over with a light wash of orange or orange with a little of the flesh color or pink added. When near the foreground a very light wash of green is applied to the foliage, but the raw green of the color set cannot be used for this; it must be modified by the addition of orange or of brown. If when applied the green appears too cold, it may be toned down by a light wash of brown, or orange or flesh color. It is desirable to produce variety in the foliage.



LANTERN SLIDE COLORING.

Rocks in the distance are washed with blue and the color is subsequently modified by washes of red or brown. Trunks of distant trees and some rocks may be left nearly the original color of the photo., but near rocks and tree trunks may be tinted with brown, blue, or warm green, and subsequently modified by washes of green, red, brown, yellow, or orange.

It is useless to trace the smaller branches of trees and shrubs, and it is rarely necessary to deal with single leaves or blossoms; when this must be done a jeweler's eyeglass is required, and fine, small brushes are used, great care being taken to keep within the outline of the object being colored. In all this work, the artist does well to remember that the coloring is to stand the test of great magnification and strong light.

The plate is apt to dry out in some places while the coloring is going on at other places. As coloring cannot be successfully done on a dry surface, it is important to wet the surface before proceeding. This is done by applying water with a soft camel's hair brush. After the surface water has disappeared the coloring may proceed.

It is obviously impossible to mention every modification of color that may be produced by mixtures and washes. This is something to be acquired by practice. The writer uses very few colors, rarely more than the following: Blue, green, brown, orange, flesh, rose, and yellow. The last is a strong color, which must be applied with caution. Green and blue are also strong colors, which can never be applied without the admixture of a warm color, or a subsequent wash of the same. Brown in different strengths has a large application. It is useful in toning down bright greens, for rocks, tree trunks, earth, etc. A wash of blue over the brown produces a different but useful gray.

The principal points to be observed are to keep the plate always wet, to use light washes, to modify color by subsequent washes, and in working up details to preserve the outlines.

After the coloring is completed, the glasses are separated, the colored film is allowed to dry, when it is placed over the picture, the two films being in contact, and a binding strip is attached to the edges in the usual way. The mat in this case is pasted on the outside of the cover.

When it is desired to color a wet plate or collodion film slide with liquid colors, the collodion film is coated with a thin transparent film of gelatin, which is allowed to dry, when it is immersed for a few minutes in a solution of alum, to toughen it. It is then washed, and while still wet, the broad washes of color are applied.

Something has been said about the permanence of the liquid colors used on the slides. The writer has many slides colored in this manner two or three years since, which have not changed perceptibly. Without doubt, continual exposure to sunlight would affect them, but it would also change any other colors used for this purpose. In a prolonged test in sunlight of all the liquid colors used on slides, it was found that the greens after a time turn yellow. Brown becomes somewhat darker. The reds and yellow remained unchanged. Blue faded slightly. But this is a test more severe than colored lantern slides would ever be subjected to. The writer believes they would retain their color indefinitely.

INFANTRY FOOTWEAR.*

By Lieut. NAT P. PHISTER, First United States Infantry.

IN considering the great number of things which contribute in a greater or less degree to the success of an army in any series of operations which may be undertaken by it, we find at every turn that we are confronted by some problem involving transportation. Assuming that all soldiers will fight equally well when actually confronting the enemy, there still remains the question as to how an advantage is to be obtained by placing in opposition to that enemy, at the most effective place and time, a force sufficient to oppose him successfully.

Whatever we may have done, or may in future succeed in doing, to increase the facilities for the rapid movement of large bodies of troops by rail or otherwise, the whole history of the art of war shows us in unmistakable terms that we can never afford to ignore the immense advantages which an army may derive from a superiority in the marching power of its infantry; and this applies with equal force to the speed in tactical maneuvers which rapidly shifts the weight to suit the event, in the hurry and turmoil of the battlefield, and to the power of sustained endurance which will, in the strategical operations of a long campaign, inevitably give a superiority to the best marchers, if other conditions are approximately equal.

Reason and precedent justify us in assuming that marching power, including in the term both speed and endurance, must always remain a prime factor in the determination of success.

The veteran of the Imperial Guard who, while on the march in one of Napoleon's rapid strategical combinations, remarked to a comrade, "'The 'Little Corporal' fights with our legs in this campaign," stated a truth which, generalized, would have a wide application in the history of war.

Preparation for war must always consist in the painstaking elaboration of innumerable details, and in the proving and improving, in peace, of the many small means contributing to the great end in view. It is my purpose herein to call attention to one of these contributory means, and to attempt to show the proper direction to be taken in the steps necessary for its improvement.

Every man who has marched at all knows that footwear is, even for the unladen marcher, of the utmost importance; and this is more apparent in the case of the soldier in campaign, who marches in all kinds of weather, burdened with his wardrobe, means of shelter, ammunition and weapons. Leg weariness wears off in a few days' tramping; the pack, so heavy at first, becomes lighter by the adaptation of the muscles to its presence, as well as by the abandonments which will surely result from the bearer's simple balancing of values between carriage and possession when at rest; but a cramped or chafed foot, in the bad shoe or stocking which caused the injury, does *not* get better with increased misuse.

If we wish to march men well, far and rapidly, or to keep them steadily going, day after day for a long time and at a telling gait, we must look to the welfare of their feet.

They should be carefully instructed how to take care of their feet to keep them sound, of course. A hygienic discussion offers a tempting field here, but it is not necessary for the purpose of this essay. Considering soldiers simply as machines, and assuming the fuel and water supply to be properly cared for, their legs will hold out if their feet will. It should never be forgotten that the mere presence of troops at a given point at a given time, however opportune, may have no value unless they are in a fit condition for the rapid marching which is nearly always necessary in making tactical dispositions for battle, and that the demands upon their speed and endurance do not cease even when a battle is won, for pursuit should confirm success.

In considering nature's means of transportation for the individual man, we find that the feet are the portions of the machine subjected to the most constant strain and to operation of external wear, and that whatever strengthens the machine or protects it from wear at this point contributes directly to both speed and endurance.

Let us then consider what are the requirements which, if complied with, will give us the desired increase in ease and power, so far as that increase may be derived from improvement in footwear.

1st. Protection from wear. 2d. Freedom of action for the foot. 3d. Lightness. 4th. Flexibility of the shoe. 5th. Fit.

The above numbers have no reference to the relative importance of the several requirements named, which are so co-ordinated that such a classification is practically impossible. The separation is only made for convenience of discussion, and the requirements are for stockings as well as for shoes.

* Graduating essay at the United States Infantry and Cavalry School.—*Journal of the Military Service Institution.*

1st. Protection from Wear.—The first protective article of footwear devised by man was probably the sandal. It really protected from undue wear, and from injury by the roughness of the ground, only the sole and the lower parts of the sides of the foot.

It was then an insufficient protection, but as far as the other requirements are concerned, its excellence cannot be questioned; and if we compare it with the sole of the modern shoe of which it is the prototype, we shall find that, however much we may have improved as to material, we have certainly retrograded as to shape. The upper has simply been added to the original sole to give protection to the upper portion of the foot. The sole must be heavy and compact to stand the wear from the ground, while the upper, having no great wear except by its own bending, may be quite light.

2d. Free Action from the Foot.—It is not necessary to go into the anatomical structure of the foot. Any reader may look at his own feet and consider them illustrative examples of the remarks herein made.

The structure and action of the arch and forward portion of the foot show plainly that it is intended to be used as a flexible, elastic, weight-bearing structure, and that anything which impairs its elasticity and flexibility must interfere to that extent with the proper performance of its natural functions.

Any one must admit that it is a plain violation of nature's laws habitually to cramp, imprison and distort any portion of the human frame, and yet as to the foot, we differ from the Chinese women only in degree. Not one adult in a hundred has any power to separate his toes when barefooted—but all babies have it.

A fair average width for the weighted foot of a medium sized man, measured across the ball, is about four inches. Measure a number of the soles at this point and you will find the average much less. In other words, the shoemaker expects either to cramp the wearer's foot down to the size of the last or to have his foot project over the edge of the sole from one-half to three fourths of an inch. The spring of the weighted arch lengthens the foot and the forward part of the foot spreads laterally; hence to fulfill this requisite we must make the sole as long and as wide as the weighted foot, and we must have no undue constriction by the upper. Can you imagine a Roman soldier or an Indian cutting his sandals narrower or shorter than the extreme measures of his weighted foot? I think not.

3d. Lightness.—It is, or should be, plain that the shoe should be as light as is compatible with the fulfilment of the first two requirements.

Most shoes intended for standing much continuous wear are made far too heavy, particularly so as to the uppers. Uppers cut from good heavy calf skin (say 5 or 6 pounds to the skin, depending on size) are heavy enough for any wear, and for that part of the shoe about the ankle there can be no objection to the use of much lighter material, such as canvas-lined sheepskin (the so-called "kid" of the trade).

Our cavalry give careful consideration to the weight of their *horse* shoes (weight of troopers' boots is four pounds) and comparing the weight of the foot soldiers' shoes (issued by the Q. M. Dept.) with these horse shoes, it is found that the soldier, whose power is rated at about 1-5 that of the horse, is expected to carry upon his feet a weight considerably at variance with the proportion of power which he develops. A recent comparison of weights resulted as below. So many different weights were given for horse shoes that the weight taken is stated upon the authority of several cavalry experts, who gave it as the proper weight for a full set of shoes for a horse of medium size.

Weight of full set of horse shoes, 48 oz.

Weight of pair of soldier's No. 8 shoes (latest pattern), 40 oz.

Weight of pair of soldier's cavalry boots (latest pattern), 64 oz.

It is as desirable now as in the days of pilum and shield that a soldier should be a trained athlete. The soldier should be a racer. We do not shoe a race horse like a beast of burden, and for the purpose of his business a soldier needs, and should have, the lightest, strongest and best of shoes. If the present shoes are intended to serve the purpose of the double weighted arms of exercise which were used by the old Romans, they are not too heavy; but if they are intended for daily use in actual business by a man from whom speed is to be required, they are far too heavy.

4th. Flexibility of the Shoe.—This is only another feature of the consideration concerning freedom of motion, but as it involves more particularly the material and make-up of the shoe, while the former consideration has more to do with its fit, flexibility is considered separately. Assuming from the start that leather is the material to be used, it may be confidently asserted that, weight for weight, there are great differences to be found between the various kinds of leather. Some leathers, notably hemlock sole leather of the usual market grades, are hot tanned, and this makes them stiff, hard and less tough. Cold tanned oak sole leather of proper thickness, and well rolled to make it compact, is eminently desirable in every respect, and, while it costs about one-third more than the hot tanned hemlock sole, it is fully worth the difference.

As to upper leather, it will be found that the tanning has a great deal to do with its quality. It will be found, also, that no such leather is good which does not include the whole thickness of the hide. The middle layer of the tanned bovine hide is fibrous, absorbent and tough, but it cannot be dressed, shaved, rolled, or pressed to a permanently smooth surface, or to any surface which will wear well, and therefore a piece of leather, originally too thick, which has simply been split or skived down to the required thickness, has been so treated at the expense of one of its wearing surfaces, and the surface so exposed is so loose and fibrous in texture that it will not properly retain dressing, rapidly absorbs moisture and soon hardens and stiffens until it will break.

Much of the "upper leather," so called by the trade, is of this character, and it is not, in my opinion, fit to make any part of a shoe to be worn on a human foot. It is obvious that the extra thickness which necessitates splitting accompanies greater age and size in the animal from which the hide was taken, and, therefore, a coarser texture of the hide, which tends to increase the defects spoken of. Our soldiers wear, or have for years worn, shoes made from leather of this kind, and the fuzzy, cloth-like appearance of the leather is familiar to every observant officer. Soldiers call them boiler iron shoes, and they deserve the name.

Lately a move has been made in the right direction by having the shoes cut from "kip" (only a trade name for hides lighter by a trifle than "upper" and sold in the whole hide by the pound; while "upper" is sold in "sides," the hide being cut in half down the back and sold by the square foot), but the reform does not go far enough, as will be seen from the weight of a pair of these "kip" shoes (40 ounces).

To get proper leather, then, we must obtain it by careful selection from such hides as by natural size and thickness (resulting from age and size of the animal) are best suited to our requirements. Well tanned calfskin is the best material to be had, and, though perhaps not so attractive to the eye, grain-dressed calfskin is better for soldiers' shoes than that dressed on the flesh side. A moment's consideration will show why grain-dressed leather is better. The skin of the animal performs excretory functions, and it seems plain that to reverse its position when putting it in the shoe is to invite the entrance of moisture; in addition to this, if the grain is out, the wear is in nature's own direction. Practice has proved the truth of the above, for sportsmen have for years used grain-dressed shoes, and they find them better. The materials mentioned above will give the required flexibility and lightness; they are easily obtainable and should be used.

5th. Fit.—From the heel to the forward portion of the arch of the foot the shoe should fit snugly to avoid slipping and chafing, and it may so fit without interfering with freedom of action, because this portion of the foot does not spread, laterally, under weight, though the length of the whole foot on the ground is increased by the flattening of the arch. The shank of the sole may therefore be narrow.

Forward of the shank, the sole should be broad, as already mentioned, and there should be no surplus leather in the upper. I refer here to a very common error made by shoemakers, some of whom seem to think that breadth of foot across the ball must always be accompanied by a corresponding increase in thickness, whereas, with feet of the same length, the converse is nearer true. The whole matter is right here—*fit the weighted foot.* If it were possible to do so, every shoe should be made to individual measure. As this is practically impossible for soldiers, what is the next best way to give them what they need? Evidently such an assortment of sizes as to length, width, etc., as will enable us to go into a quartermaster's storeroom and fit, with a comfortable shoe, any man whose feet are not abnormal in shape or size.

Can this be accomplished? Unquestionably it can.

A good shoe dealer can, from his stock, fit almost any foot (*military* foot not here understood), and there is no reason why the Quartermaster's Department should not be able to fit any soldier's foot. The fact that soldiers' feet are all examined and passed upon by competent surgeons narrows the limits of variation so much that no very great diversity of shapes and sizes would be necessary to meet every demand. It cannot be urged that much stock would be left on hand, for with dimensions fixed between reasonable limits, the law of chances would take care of the rest. Keeping such an assortment pays the dealer, who calculates upon probable diversity and demand with far less certainty than would be possible for a supply department of an army. Go into any large shoe store and they will present for your selection from six to a dozen different widths and shapes of the same style of shoe at the same price.

A few years ago the government spent $10,000 to have an alleged expert go through the army teaching a system of horse shoeing (he and his system are anathema maranatha among our cavalry officers to this day, and the crippled horses have died or been sold—but the money *was* expended). A much less amount, judiciously expended upon and by one of the few really scientific shoemakers in the country (for there are a few who are pretty well known as specialists in their line) would probably result in a vast improvement in military shoes. Such a man, by comparison of data, which could easily be furnished him, or which he could easily obtain, would be able to determine what variations in size and shape would be necessary, and to fix the shapes of a full set of military lasts, which would insure the success of a system by which each individual soldier could be fitted as a shoe dealer fits a customer. The soldier's shoe would be improved in fit, comfort, and utility, provided the system was adopted and that proper materials were used—but we would probably have to abandon some wrongly preconceived ideas as to style.

We may reasonably suppose that the improved shoe would be of grain-dressed calfskin, medium weight, hand-sewed, with a heavy oak-tanned sole projecting slightly beyond the upper, with a flat shank and a low broad heel, with a smooth insole slightly dished at heel and ball; with a wide sole at the ball slightly greater than that of the weighted foot, and with the upper across the ball so cut that there would be no slack leather. The shoe would probably be a half boot shape, lacing with a few holes over the arch and having soft loose tops about the ankle, which would leave the ankle free to develop, as it would, a strength and elasticity proportioned to its work. I do not consider it necessary or advisable to support the ankle by tightly laced leather. The sinew and muscle developed by exercise are the best supports for any part of the framework of a soldier. The sole of this improved shoe would be as nearly as possible the shape of the bottom of the weighted foot, and slightly rounded off at the toe for increased protection to the ends of the smaller toes. A light metal plate at toe and heel would increase the life of the shoe.

Such a shoe would not be pretty or stylish, but it would not hurt the soldier's foot and in it he could march far and fast and come in still fit to move rapidly, provided that his other needs were cared for.

Right here it is proper to speak of a recent article by a French officer upon the subject of the peculiar fatigue resulting from marching. In saying that this fatigue and nervous strain results from the continued rhythmical repetition of a jar, transmitted at each recurrence in the same direction through the same bones, muscles and nerves, this writer has only formulated a principle well known to every man who has marched much; but I do not think much of his remedy, which consists in the use of an elastic cushion under the heel. An American invention, on precisely the same principle, is advertised for the use of nervous invalids, but soldiers are not usually of that class. If we have to deal with a recruit who jabs his heels into the ground, we can correct it. Elasticity of tread comes with practice in marching, and with the strength and proper development of muscles which are its legitimate result.

As to the durability of such a shoe as has been mentioned, it may safely be asserted that with some slight attention from the cobbler, who with some of the simplest tools of his craft and a supply of leather should accompany each infantry company, two pairs of such shoes will, over ordinary roads, wear for 1,700 miles, which is a greater distance than any soldier would probably have to march without an opportunity to renew his shoes. The net cost would be about one half a cent per man per mile. Each soldier should have furnished to him to be cut by the cobbler, after his shoes are well broken to the foot, sufficient sole leather for a pair of slip soles, which should be cut accurately to fit the inside of the shoe. The advantage of these slip soles when on the march is very great; they can be taken from the shoes, beaten together to remove the dust, after being dried in the sun, and then replaced for the next march; thus keeping the inside of the shoe fresh and clean. It is an open question whether one pair of such shoes and a pair of light camp slippers would not be a sufficient supply for the soldier to carry on his person in campaign. Casualties would furnish many opportunities to renew shoes.

It is a little curious, to one who has never thought of it, how the cost of shoe leather foots up, and how easy it is to reach an approximation to the cost by a simple calculation, provided one has, to start with, a few data as to the distance one pair of shoes, of known cost, is good for.

I have made some experiments in my own case as to this, and have above given the result of them and of a careful observation of these matters for about ten years.

As to the issue of a better shoe, of the kind described, to our army, the question of price need not enter the discussion at all so long as the increase is not too great. Such shoes can be made at a cost of $4 per pair, which, considering quality, is no great increase on the present list price ($1.89) of the sewed campaign shoe. For a soldier, a good shoe, like a good rifle, is beyond any paltry consideration as to price.

Another thing should be spoken of here. If a shoe is good enough for a soldier to march in, it is good enough for him to wear at any time when on duty, and nothing but the high class (unstylish) marching shoe should be issued at all, unless the light camp slippers spoken of should be adopted.

Having determined to issue the shoe and having employed our specialist to determine sizes, etc., we would probably have for issue of each size of shoe by length, say nine sizes. For example:

Shoes No. 6.

	High Instep.	Medium Instep.	Low Instep.
Width,	A	A	A
	B	B	B
	C	C	C

The number of widths need not exceed three, since the variations in the weighted foot are much less than in the unweighted foot, and besides, we do not consider style as an element of selection.

Taking Recruit Ferguson into a quartermaster's storeroom where all the authorized sizes of shoes are kept, we would have no difficulty in fitting him with a proper shoe. An officer should be present and see to the proper fit of this first pair of military shoes, and there would be no trouble afterward. It would appear on Ferguson's descriptive list that his size was, say, No. 6 medium B, and requisition could be made accordingly; but Ferguson should not be allowed to draw a shoe of different size without first exhibiting to an officer the fault of his last shoes, nor without an officer to supervise the fitting of the new ones.

I have indicated three divisions by height of instep. It is possible that a tabulation of many measurements would show that some other dimension should be made the basis of division, but the principle would be the same. I have only intended to indicate the main features of a system, not to elaborate finer details; for that the services of a scientific shoemaker should be obtained.

I have spoken of a cobbler's wagon. It is a necessity; no forge, forge wagon or battery wagon is so much so. Some arrangement for mending the shoes of the soldiers during campaign should always be made.

So much for the shoe.

A much more neglected article is the stocking. More blistered feet, corns, ingrowing nails and overlapping toes result from ill-fitting stockings than from bad shoes. With the stocking the fault is nearly always the same—narrowness at the toe; and the present issue stockings have it.

The stocking should be of cotton, soft woven, seamless, and shaped like the foot.

A recent writer says, "So unheard of is hosiery of the exact shape of the foot, that some one has recently acquired a patent on it in this country." Comment is unnecessary.

The stocking should be held up so that it will not wrinkle at the heel and produce blisters. A soldier with calves on his legs cannot keep his stockings up properly without garters. Garters are not objectionable if they do not tightly bind the leg, and modern ingenuity has overcome that objection. To complete the comfort and security of the soldier's nether extremities, we have the present canvas legging. It is excellent, and would go well with the proposed shoe, but the pattern might be improved by narrowing the ankle slightly.

It was not intended in this brief essay to write a history of shoes, to compile data as to their use and abuse, or to give a perfect system by which perfect shoes could be procured and issued, but only to point out a few of the essential particulars in which the footwear of our infantry could be improved, and to call

attention to the importance of improving it. No part of the soldier's clothing or equipment is more important. A soldier can and frequently does fight in his shirt sleeves and bareheaded, nor is his military efficiency impaired by a canvas patch on his trousers, but if his shoes give out or his feet get sore he will not be on hand to fight at all. By the failure of the shoes, the man, his arms, and his ammunition are lost for the fight.

During the time I have taken in observing this matter, I have marched about two thousand miles, all told, and have closely observed and questioned the men of my company about their shoes. I have seen about five per cent. of a regiment of three hundred men disabled for hard marching by sore feet, in a march of ninety miles over good roads, going at the rate of about twelve miles per day; and, as a contrast, one company of the eight present in that regiment went through without a sore foot in the entire company, simply because its captain had looked carefully to his men's shoes, and had each man prepared with well broken, well greased shoes of proper size. (It was not required that the men of this company should wear the issued shoes, but no shoe might be worn unless the captain approved it.)

In war five per cent. would be a heavy interest to pay for poor economy.

This whole matter, while worthy of the close attention of all military men, is, comparatively, a neglected field. The subject is a homely one, and has none of the attractive glitter of more pretentious themes, but it is worthy of much thought and deserves a better presentation from some more skilled and facile pen than mine. The great Napoleon hanged a contractor for stuffing soles, and he discovered the fraud by cutting up a shoe with his own imperial hands. Wellington is said to have enumerated the three most essential articles of a soldier's equipment as: 1st, a pair of good shoes; 2d, another pair of good shoes; 3d, a pair of half soles.

The feet of the soldiers of our army are among its most effective weapons, and they deserve and should receive all due care, and the army in which this care is neglected will bitterly regret the omission at a time when it has much more than vain regrets to occupy its attention.

THE LEGAL RESPONSIBILITY OF THE AGED.

By J. J. CALDWELL, M.D.,* Baltimore, Md.

HISTORY is replete with the failings of old age. The exceptions are rare and stand out like meteors.

"There is a senile dementia, and a form of dementia associated with general paralysis. Dementia also has its degrees and its stages of forgetfulness, irrationality, incomprehension, and inappetency. A patient suffering from dementia, as he passes from bad to worse, first exhibits a want of memory, then loss of reasoning power, then inability to comprehend, and lastly, an abolition of the common instincts and of volition.—P. 50, 'Field's Medico-Legal Guide.'

"In the progress of this mental disorder the mind usually dwells only on the past, and the thoughts succeed one another without any obvious bond of association.

"Delusions, if they do exist, are only temporary and leave no permanent impression, and for anything recent the mind is exceedingly weak. If it occurs as acute dementia in young people, it is generally incurable. In old men, in whom it most frequently occurs, it is called senile dementia, and indicates the breaking down of the mental powers in advance of bodily decay. The persons may become oblivious of names and dates."

Professor George M. Beard, now deceased, the great neurologist and electrician of New York City, and author of an elaborate work on these subjects, has divided a paper read before the Medico-Legal Society of New York into three heads, viz.:

1st. What is the average effect of old age on the mental faculties? In other words, what is the law of the relation of age to work?

2d. To what extent is the average responsibility of men impaired by the change which the mental faculties undergo in old age?

3d. How shall the effects of age on the mental faculties be best brought to the attention of our courts of justice?

These questions have been a life-long study with this scientist, who set about making his investigations without fear or prejudice, and in the full hope that the result of his researches would be made available in deciding the condition of the minds of men past the full maturity of life.

Dr. Beard has deduced these general results from his prolonged investigations, viz.:

The golden decade is between	.....	30	and	40
The silver	"	"	.....	40	"	50
The iron	"	"	.....	50	"	60
The tin	"	"	.....	60	"	70
The wooden	"	"	.....	70	"	80

He found that 70 per cent. of the work of the world is done before the age of 45. Nearly all the great systems of theology, metaphysics, and philosophy are the result of work done between 20 and 50 years of age. And this law holds good in animals and plants as well. Horses live about 25 years, but they are at their best from 8 to 14. Dogs live 9 to 10 years, and are best for hunting purposes from 2 to 6 years. Children born of parents healthy in middle life (from 25 to 40 years) are stronger and smarter than those born of parents either younger or older than these extremes; and the same fact applies to the breeding of other animals, as in horses, dogs, and cattle. The hen has her best laying capacity at her third year. She will lay in an average lifetime, say 9 years, from 500 to 700 eggs. In her first year only 18 eggs; in her second year, about 110; in her third, 130, the golden period; her ninth year, only 10 eggs, if any. In old men the faculties morally deteriorate, as do the physical.

This does not necessarily make an old man a bad citizen in the true sense of the term, as of a neighbor or a harm-producing person. But unless sustained by a higher power, he is apt to give a looser rein to his feelings and expressions, to display irritability, less consideration for the feelings of others, and if he has had any variety of brain trouble, this is apt to reflect on his every act.

The diseases to which the brain is liable through a long course of years are many, such as blows, destroying the memory of names, dates, locations, and events; a bereavement has destroyed the memory of names alone. Millionaires once known for their liberality have grown stingy in old age. Hemorrhage in the brain and the various disorders within the cranial cavity have suddenly or more gradually made the clever foolish, the patient petulant, the hopeful despondent; have caused men and women too to change almost instantaneously their religious and their political doctrines. When the intellect is impaired by disease of any kind, or by the decay of age, men cannot distinguish the true path as of old, even when they desire to do so.

The changes in the brain from old age much resemble a diseased condition, either like the result of hemorrhage from the giving away of the cerebral arteries, from thrombosis, from hardening of the arterial coats, from meningitis, congestion, from anæmia of the brain substance, from nerve tissue decay, and from softening; and death in aged persons is more frequently a process than a sudden event, the process being one of very gradual, incapacitating decline of the mental faculties. An old man may begin to die ten or fifteen years before the absolute death of his body really occurs; and, like a tree, he may die beginning at the top and going down to the trunk. The decline in the moral faculties in old age may be shown in studying the lives of such men as Demosthenes, Cicero, Sylla, Charles V., Louis XIV., Frederick of Prussia, Napoleon, Voltaire, Dr. Samuel Johnson, Oliver Cromwell, Ruskin, Dean Swift Milton, Lord Bacon, Webster, and Horace Greeley. Old men decline in various faculties, some becoming peevish, others avaricious; some mean, filthy, and tyrannical; others quarrelsome, sensual, unjust, revengeful, and ungrateful for past favors and kindness.

The best average barometer of mental force is the memory, and decline or any deterioration in the power of the memory is the advance guard in old age, which sooner or later invalidates the forces of the brain. Most men show their mental powers in middle life, while their advanced years are the periods when they apply and reap the harvest of the work executed or planned in their palmy days. Thus Lord Bacon, Swift, Dickens, Ruskin, Thackeray, Carlyle, Emerson, Wendell Phillips, Graefe, Pinel, Luther, Nelson, Harvey, Webster, Jenner, Jefferson, and Washington did their best work before old age got the better of them. Sterne said that "At sixty years of age the tenement gets fast out of repair;" and Emerson says, in his "Plea for Old Age," "We cannot count our years until there is nothing else; to count," and added, "We postpone our literary work until we find that our literary talent was a youthful effervescence which we have now lost." Dr. Oliver Wendell Holmes says: "New ideas build their nests in young brains, and the whisperings of new truths are not caught by those who begin to feel the need of an ear trumpet."

General Halleck, in his work on "Military Science and Art," shows that mainly all the successful campaigns of history have been fought by comparatively young men, men in the prime of life, and that most of the early successes of Napoleon were gained over old and worn-out generals.

In the late civil war of the States, the North began with old generals, and failure was the result, and the average of the later generals who finished that contest was between thirty-five and thirty-nine years. We find the average age of the fifty-six signers of the Declaration of Independence was between forty and forty-five years of age.

Mr. Guernsey, of the New York bar, said: "From twenty-five to forty may be considered the seed time of life; that is, the time when knowledge is accumulated, and stored up for future use."

There are three causes of moral decline in advanced life:

1st. Is the overtasking and overexercise through adult life of the physical and the intellectual faculties, to say nothing of early sexual abuses.

2d. Diseases of the brain, or of other organs, which react on the brain.

3d. Intellectual decline, or the gradual process by which all living beings decay and die.

The question of legal responsibility comes up in old age:

1st. As to cases of crime by aged persons.

2d. Cases of wills, which are disputed on the ground of senile incapacity.

3d. When it is desired to fix the limit, as to term of office, etc.

4th. As to cases of priority of invention, etc.

Corruption in business and in political life and breaches of trust are common among the old, as every day's papers inform us. Offenses which depend upon sexual passion are not infrequent among the aged, for it is well known that in the decline of life many return to the vices of their youth. Even clergymen, old men, have been charged with such irregularities.

Cases of wills contested on the ground of senile incapacity are frequent enough, often giving rise to much trouble and estrangement among members of the same family; and an evident presumption would often lead to an incapacity to dispose of by will wisely the accumulated possessions of a lifetime.

A man in the decline of old age may be irresponsible more or less in one or more directions, while responsible in others. Few men break down all at once merely from decay of powers, but the faculties leave one by one, as the one first becomes defective, or softened if of the brain, while the others remain for a while longer fairly healthy, as an army in retreat moves off, some holding their position while other regiments fall back. Thus the wear and tear of aged persons may be rapid, save where money, the touchstone of life, is concerned, for the old man cares rather for the money *in ipso* than for the good that money can bring. Grudge or personal spite, unnatural enmity against a person, relative or not, often occurs in advanced age, amounting even to more than a disagreeable eccentricity, to almost a disease, and may influence judgment even against those who have been kind and affectionate toward the individual. It is difficult and generally fruitless to endeavor to remove this prejudice.

Then the aged are liable to be deceived by designing persons and have influences exerted over them which in their better day they would have seen through or have not tolerated. The case of Horace Greeley may be cited as an instance of the irresponsible condition of an old man, he becoming inordinately fond of money as soon as disease invaded his brain, and yet he became insane the last week of his life and his will was disallowed.

When an old man, previously benevolent and wealthy, becomes in dread of the poor house and begrudges the fuel for his family, the meat on his table, and the clothing for himself and his family, there is reason to suspect very serious cerebral disturbance, which might suffice to incapacitate him from making his will.

An instance may be cited of an aged clergyman, who all his life had been mean and penurious. In his golden decade, in his thirty-fifth year, he had been a minister of the gospel, a noted preacher. Between seventy and eighty he became worse and worse; becoming a genuine nuisance. He lost his memory and his manners; lost his wife; he then married again under the most absurd circumstances; was then divorced from the wife, and again married. He then went into gross excesses; lost his physical health, which up to that time had been excellent, and finally lost all his money through the treachery of this last wife, who in the end deserted him in his poverty and in his imbecile condition. This man had during all these years made will after will. His friends now took him in charge and treated him as a confirmed imbecile.

Dr. Brigham, of Massachusetts, says that in this country insanity and other forms of brain trouble are three times as prevalent as in England, and Dr. Winslow, a celebrated expert in insanity, says: "In the incipient stages of cerebral softening, as well as in organic disintegration of the delicate nerve vesicles observed in what is termed progressive, general and cerebral paralysis, ending either in apoplexy or in progressive paresis or in childishness. In such cases the patient often exhibits a debility of the mind, of body, and of memory more especially, long before the disease of the brain is suspected in regard to the most trifling affairs of his life. He forgets his appointments, or goes to keep them before the appointed time. He is forgetful of the names of his particular friends with whom he has lived in the closest intimacy; he becomes irritable, mislays his books, loses his papers; he sits down to write on some matter of business, and his attention being diverted for the moment, he forgets and leaves his letter unfinished."

The memory may be considered one of the most delicate tests of the presence of injury or of the progress of natural mental decay in the brain. The case is cited of an old man, who could never recollect the names of the inmates of his establishment, recalling only the initial letter of each one. He accordingly kept about him a list of their names so as to indicate them.

Old age, wear and tear, will, like pressure from a bone on the delicate substance composing the brain, produce more or less complete death of the sentient being for the time. One of the early indications of softening of the brain is seen in the paralysis of the muscles of the face, *i. e.*, the drawing down of the eyelid, and the distortion at the angle of the mouth from paralysis of the corresponding muscles of the other side.

In many instances these irregularities and extravagances are but the premonitory symptoms of softening of the brain, that terrible malady, incurable, and which gradually destroys, one by one, the powers of mind and body, and reduces the poor sufferer to a living death. Sensations as of cold, numbness, pain, and of increased warmth at times may all be felt in a perverted state; in some everything touched feels cold; others can bear only the lightest wraps in bed on the coldest nights of winter.

Professor Simpson, of Edinburgh, knew persons with incipient signs of general paresis to complain of their fingers feeling like sausages, cold and fleshy; and it is well known that on the approach of a paroxysm some have had such a feeling about the tips of the fingers as to lead to the habit of biting their nails, and this habit is known to exist in many inmates of insane asylums. The manners in such people are very variable, being different only in that the feeling of numbness and inertia persist and are on the increase all the time with them; while in the adult healthy individual, if this condition comes on at all, it forms a brief attack following generally a recognized cause, and then leaves the party almost, or as well, as before the attack.

It is the opinion of many eminent physicians that there has been a large increase of brain diseases during the present century, and that this increase has occurred in an accelerated ratio in proportion as the strain in commercial and public life of the people has increased, making the struggle for position, for wealth, and even for existence so much more difficult than formerly, when man's ambition was to live simply and to follow the golden rule, thus requiring increasing struggle for the luxuries of life, which finally culminates in cerebral excitement under which the delicately organized brain is forced to yield. Eccentricity is but a name often covering painful afflictions, and any prolonged exaggerated conditions of eccentricity may be said to constitute disease (page 89, "Work on the Border Land of Insanity," by Andrew Wynter, Esq., M.D., of London). Many mental eccentricities are but the forerunners of serious mental failure. The inability to grasp a stick, the continued numbness of the fingers, the loss of memory in small matters, are often indications of serious cerebral disturbance. Dr. Graves, of Dublin, a distinguished physician and writer, cites a case, who could never remember proper names; and Dr. Samuel Johnson, the great English scholar and writer, the author of the beautifully selected passages in Rasselas of the Happy Valley, would attempt in vain to repeat the Lord's prayer in English in his later days, and yet he could repeat every word of it in Latin.

Dr. Samuel Rogers, the poet, in his later years, showed peculiarities of memory, very like those of persons known to be suffering from disease of the brain; he even forgetting that he had been a poet. This is an uncommon form of loss of memory, for once a poet, a man thinks himself a poet forever. Throughout history, from the ancient fathers to our own times, we find like failures for the period of old age. We need

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only cite the famous John Randolph and that great jurist Samuel Tilden, of New York.

In the Bible we read of David and the follies of his old age; of Solomon and his foibles with the fair sex; of the valor to-day and the cowardice to-morrow of Elijah, in his flight from Mount Carmel; all in the extreme old age; of Moses, the law-giver, who organized the Mosaic code, finally disappearing and wandering in the mountains lost to memory and to history, so that with all his legal lore he had not the mother wit to keep his bearings, or to leave his final testamentary evidence for future generations.

It has been said in this trial that many cases might be cited in green old age, where great ability and wonderful acumen were maintained even to the day of death. Such cases when seen at all are like angels' visits, few and far between, and "they stand out like meteors in the midnight sky."

Now comes a review of the last great

"Scene of all
That attends this strange, eventful history,
Is second childhood, and *mere* oblivion—
Sans teeth, sans eyes, sans taste, sans everything."

And we may add to this doleful picture sans will, sans memory and sans care for those who loved him.

See the picture of this poor old man, shrunken; not in his locomotor power alone, but in mind, and failing in his powers of memory, without which the noblest work of the Creator becomes useless, helpless, motionless and reasonless on the tide of life; is at the mercy of the slightest breeze by friend or foe—whichever most caters to his present whims; or like the feather tossed by the stormy waves, it was something once, but wilted and weighted down by the moisture of the sea, it is but a creature of chance. This old man was lame, blind, halt, toothless and his "voice had fallen in tone from the mighty starboard watch ahoy!" to the childish, feeblest piping and whistling, like the tiny reed; or like the creaking door, in his strength, left to rust and droop until no longer with any to care for it, in the end it tilts and falls, carrying danger in its fall. On top of and above all these threescore years and ten, he suffered from the grippe, that prostrating, debilitating, life-destroying grippe, which takes its name from the French word "tongs" or "seizings." The French are very *au fait* in their use and application of the proper words. This disease is known to the Italians as "influenza;" to the people of the far South as the "dengue," or break-bone fever, and in England as the "epidemic bronchitis." It is fearful in youth, prostrating to adults and fatal in old age.

In connection with all this disability, lasting many months, this old man attempts to publish his will. Often then he says to his brother and to his elder sister: "Don't you worry; I have already provided for you." He thought he had made this provision, no doubt, but on the contrary he utterly forgot to mention them. Poor old man! His good intentions took the place of good actions, which he thought performed, until at last he had neither will nor memory, but existed like a plant—simply on the sap that was left and on the light of other days. This honorable jury must forgive him, for he knew not what he did, being irresponsible and living on the visions, the *ignis fatuus* of past recollections—merely a creature of habit and repetition.

Thus his constant effort in business was a mere matter of habit and but the shadow remaining of his former good intentions toward those who were justly entitled to his beneficence. He did not even recollect the amount of his income, nor did he provide for over one-third of it, and the little he did attempt to will he divided to those he had forsworn. His memory was but a fume, a mist, like the froth on the beer glass—now present like a bubble, and then gone to rise no more.—*Med. and Surg. Reporter.*

THE OUVIRANDRA FENESTRALIS.

THIS magnificent aquatic plant is remarkable by the nature and aspect of its leaves, which recall a fine and elegant piece of lace. It inhabits the waters of Madagascar, where it was discovered for the first time by Dupetit-Thouars toward the end of the last century. It was the Rev. Mr. Williams Ellis who introduced it into Europe. The following is an extract from a letter that he wrote to Sir William Hooker on the subject:

The rarest and most interesting object that was worth my last visit to Madagascar is the beautiful aquatic plant called *Ouvirandra fenestralis.*

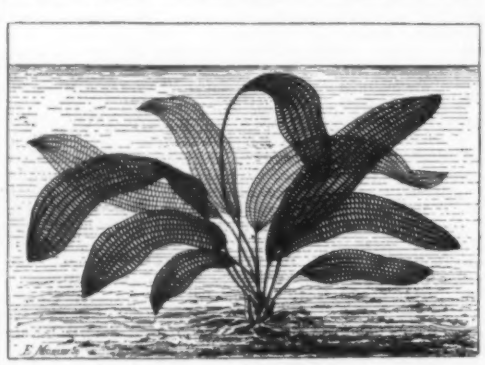
Dr. Lindley, among various plants to which he had called my attention before my departure from England, had particularly recommended this one to me in showing me a figure of it in Dupetit-Thouars' work. In the Isle of France, Mr. Boyer, a distinguished naturalist who once lived in Madagascar, pointed out to me liberally the localities in which I might stand a chance of meeting with the plant, and permitted me to make a copy of the plant already mentioned. This copy, made upon a larger scale than the original, was shown to the natives, and I finally succeeded in finding a man who was able to detect the natal place of the so much coveted plant. With the permission of his master, from whom I had received many acts of politeness, the man started out to look for the *Ouvirandra.* He returned two or three days afterward stating to me that he had met with it in a stream, but that he had been unable to secure it on account of the large number of crocodiles that the recent rains had caused to crowd to this point. Finally, he returned to the charge and brought me some samples in a very fair state, for which I was delighted to pay him liberally, and which I immediately took in charge.

The natives describe the plant as growing upon the margin of running water. The rhizome has a diameter of about 5 centimeters by from 18 to 27 in length. It is often branched in various directions like that of the ginger or curcuma, but is always in a single continuous piece instead of being formed of joints placed end to end. The plant is fixed to the margin of streams by numerous white and slender rootlets that penetrate the mud and clay and keep firmly fixed therein. It grows likewise in stations that become dry at certain periods of the year, and, under such circumstances, the leaves, it is said, are destroyed, but the rhizome preserves its complete vitality and puts forth new leaves as soon as the water moistens or covers the plant.

This plant is one of importance to the natives, who collect it at certain seasons of the year for food. Its rhizome, when boiled, furnishes a farinaceous substance analogous to that of the yam, whence its native name *Ouvirandra*, which means, literally, "water yam," *ouve*, in the Madecasse and Polynesian languages, signifying "yam," and *rano*, in the former dialect, "water."

The *Ouvirandra* is not only curious and rare, but also very beautiful in color and structure. From the various heads of the rhizome ascend, sometimes from a depth of 30 centimeters, a certain number of graceful leaves borne upon frail petioles, and that extend horizontally just under the surface of the water. The peduncle starts from the center of the leaves and terminates in two geminate spikes. But the leaf is especially eminently curious. One might call it a living fibrous skeleton, rather than a perfect leaf. The longitudinal fibers, extended in curved lines from the base to the apex of the limb, are united transversely by numerous filaments that form right angles with them, the whole exhibiting exactly the appearance of lace or a green embroidery. Each leaf exhibits itself at first as a short and delicate fiber, of a yellow or pale green color. Its sides soon develop, and its dimensions increase. At the various phases of their growth the leaves pass through innumerable shades of color, from pale yellow to dark olive green, and, later on, when they become destroyed, to dark brown, almost black. They attain a length of 30 centimeters and a width of 0·07 meter. I succeeded in carrying my plant to the Isle of France, where, for more than a year, I preserved it in full vigor. It seemed to prosper, especially in running water at a temperature of 74° Fah. I had the pleasure of offering specimens of it to Mr. Boyer, as well as to Mr. Duncan, the director of the Pamplemousses Botanical Garden. At the Cape of Good Hope, Mr. Gibbon had the kindness to take care of it during a five months' voyage that I made in the interior, and I left a specimen of it at the botanical garden of Cape Town. Upon returning to England, I had the great satisfaction of being able to offer this rarity to the Kew Gardens, and to those of Chiswick and Regent's Park.

The species under consideration is not the only one of the genus, for there is also the *Ouvirandra Heudeloti*, Kth., which inhabits Senegambia, and the *O. Bernieriana*, Dene, whose leaves are longer, narrower and more ribbony. These plants belong to the order Hydrocharidaceæ.—*La Nature.*



THE OUVIRANDRA FENESTRALIS OF MADAGASCAR.

AMERICAN APPLE EXPORTS.

THE apple export trade from this country to England is by no means a new business, for as long as fifty years ago lots of a hundred barrels and upward were sent forward in sailing vessels that took from four to eight weeks to make the voyage. Ten years later slow steamships landed the fruit in from eighteen to twenty-five days, though not always in sound condition. Until 1870, 500 barrels of apples were considered a large shipment, but since 1875, with swifter steamers, the business has greatly increased, and is now a regular department of the fruit trade in which some fifteen firms in this city are engaged, besides half a dozen shipping brokers who see to arranging for space on the steamers and attend to other details of transportation.

In 1880–81, a season of good crops, the enormous quantity of 1,159,380 barrels went to Europe from United States ports alone. The carefully compiled reports of Mr. Mahlon Terhune, of this city, for the years since 1880, show great variation in the quantity of yearly shipments, the result of abundant or short crops. For example, in 1892–93, more than 650,000 barrels were shipped from New York, Boston and Portland; of these apples almost 250,000 barrels, or nearly thirty-eight per cent., were grown in Canada. The shipments made direct from the Canadian ports, Montreal and Halifax, amounted to nearly 546,000 barrels.

The apple export season dates from August to May, and from advance sheets of Mr. Terhune's statistics of shipments for 1893–94 it appears that the minimum quantity of less than 70,000 barrels went out from the United States this season, and but 86,000 barrels from Canadian ports.

These figures indicate, with the single exception of 1883–84, the dullest apple trade in twenty-five years. Reasons for this unusual export market are found in a short crop, made still smaller by the heavy storms of last autumn, large importations to England from other countries and the prevailing hard times. These exports, although comparatively small, were large enough to diminish appreciably the stock already insufficient for home use, so that prices have ruled unusually high in this market.

The first apples are shipped abroad about August 1, Keswick Codlins, from New Jersey, being the earliest export of last year. The Orange Pippin, a better fruit, follows closely, but the export of these tender summer apples is always attended with risks, and as they are needed at home, shipments are likely to continue small. During the year almost every variety of American apple is exported, and Fameuse and other delicate apples stand the journey well, Red Astrachan being one of the few kinds which rarely arrives on the other side in good condition. Redskinned apples are preferred in England by the masses, and the attractive King apple is in especial request early in the fall. But there are not enough of these, and in recent years Greenings, which come into market about the same time, have gained a place in spite of their inferior color. But the great export apple is the Newtown Pippin, the first American apple shipped to England. Coming originally from orchards in Newtown, Long Island, the best of these apples are now grown in the mountain districts of Virginia, where they are locally known as Albemarle Pippins. Here the fruit matures early and is ready for shipment by the 10th of November. These pippins, grown on Long Island and in the Hudson River district east of that river, mature later and are not fully ripened and well colored before January. On this side of the continent Newtown Pippins are grown only in the sections indicated. But the Northern orchards are dying out, and efforts at propagation are not successful, and the fate of the Spitzenberg twenty years ago threatens this fruit. Westchester County, formerly a great center for these apples, now produces small scaly fruit, and it seems to be only a matter of a few years when there will be none of these apples grown in the North. It has been thought by some that if the trees were not started from root-grafts, but were grafted high up on some vigorous seedlings, they might once more succeed where they are now failing.

In the Virginia district the fruit grows large and of excellent quality. In New York State three heavy storms last autumn cut prospective orchard harvests of fifteen hundred to two thousand barrels down to a few hundred barrels, but in Virginia the damage was slight and the crop was large and of the good quality which attends a full-bearing season. Quite as many Newtown Pippins went abroad, all Virginia fruit, as in other recent years, and at paying rates, prices in England ranging from 25 to 40 shillings a barrel for No. 1 fruit. They are largely used for table decoration there, and their rich flavor commends them highly, while they have also the crisp and sour qualities demanded in the English market. Their firm flesh and tough skin especially adapt them for packing and shipment, whereas many kinds, such as the Northern Spy, are easily bruised and discolored. The Newtown Pippin is much better known in England than it is here, since nearly the entire crop is exported. Christmas presents of these apples have long been fashionable, and banking firms in this city send abroad sometimes as many as fifty barrels to their business friends. More Newtown Pippins were offered in our markets this season than ever before, owing to the scarcity of other apples, but these were mostly second-rate fruit from this State and culls from Virginia, which in ordinary seasons would find no sale here. The stock of Newtown Pippins is always exhausted by March, and this year exports practically ended with the holiday trade.

Among the latest apples usually shipped are Northern Spies, which remain juicy and highly flavored to the end of the season and are sought after by the best trade. More Baldwins are usually shipped than of any other sort, and these are even later keepers. It has been said of Russets that they are an instance of the survival of the unfittest, but their merits are appreciated by a large number of buyers, and this apple ranks fourth or fifth in quantity exported. It is the longest keeper of all American apples, and is often shipped in April, while it has been sent to Glasgow and to English ports as late as June.

The firm prices which continued in England until February were then broken by large receipts from the Continent, and the demand for such American apples as were still held there was also affected by large receipts from Australia and Tasmania. The bulk of supply in England is, however, drawn from Canada, some of the best apples coming from Nova Scotia. These are of a quality superior to those grown in the United States and have remarkable keeping qualities. Transportation to England costs hardly more than freight into the United States, so that English markets stand the first chance with Canada shippers, especially as there is also a duty of eighty-four cents a barrel on apples brought from Canada into this country. So large a supply of Canada apples found their way to England last winter that prices were often $1 a barrel less than the same fruit brought here. The average wholesale price for apples in New York for the season of 1892–93 was $2.50 a barrel, and for the season just passed $4.50 a barrel.

Many of the apples exported come from Western New York; the largest apple farms have storage houses or cellars provided, and these are also found in many towns, for neighborhood use. At the beginning of winter the storage house or cellar is filled with cold air and closed up with the temperature at 28 or 30 degrees. Later in the season, when the temperature inside rises to 35 or 40 degrees, cold air is again let in. By this means apples are kept until the end of winter without ice. For late holdings cold storage is necessary. Shipments are usually made to commission dealers in the seaboard cities, by whom transportation is arranged for through a shipping broker. The fruit is sent on fast passenger steamships and is stowed in the hold away from the engine and boilers, generally in the forward part of the vessel, where the ventilation is best. In the early years of the trade apples were carefully wrapped in paper and packed in cork or mahogany sawdust, but no special precautions are now taken beyond having perfectly sound fruit. Shipments vary from 500 to 1,000 barrels, sometimes as many as 8,000 going on a single steamer. The fruit is consigned to an English agent, who remits the proceeds of sale after deduction for ocean freight, besides expenses for landing, harbor dues, delivery and sale. Cable advice as to prices is sent to the dealers on this side, and shipments made on such advice naturally result in gain or loss as the English market may happen to rise or fall. New York merchants tell of losing as much as $3 a barrel, while the highest authentic price ventured upon by a veteran dealer is 105 shillings a barrel for a half-dozen barrels twenty years ago.

The season here is nearly ended, and the few apples held in the interior of the State for trade values will all be disposed of before the new crop comes in from

the South. Roxbury Russets, Baldwins and Golden Russets are the only sorts quoted in the market reports. These now arrive at the rate of about 300 barrels a day and bring at wholesale $6, $5.50 and $5 a barrel. Dealers have recently divided their barrel stock into bushel lots, and these are offered in boxes at barrel rates.—*M. B. C., in Garden and Forest.*

FAIR FORESTRY OUTSIDE OF THE UNITED STATES.

By JOS. CRAWFORD, Ph.G.*

OUR neighbors on the north were very kind, hence we will talk about them first, combined under the general term Canada, and contained in one inclosure. They were the following, namely: Prince Edward's Island, Novia Scotia, New Brunswick, Quebec, Ontario, Northwestern Territory and British Columbia, with special mention of exhibits of Quebec, Northwestern Territory and Ontario.

These showed their vast timbers by sections of the trees, cross and longitudinal, plain and polished, as well as some very large sized boards, among them arbutus wood, which is not represented in the States.

Manitoba having such a good general collection, stood on her dignity and would not accept the small space allotted her, but erected a commodious building outside the fair grounds on Stony Island Avenue, opposite the California building, and there displayed her products to not only her satisfaction, but all visitors also.

A warmer neighbor, Mexico, presented to our view a very complete set of timber specimens, mostly of dark woods, but not well classified, and having lost our Spanish somewhere en route, we did not recover it until after sampling their genuine Zapote chewing gum, then these are what we saw and read: Under the South Colonnade, a mahogany log, 43 feet long by 41 inches square (Swietenia Mahogani), ebony (Diospyros ebeneum), bombax (Acacia Acapulcensis), mulatto wood (Xanthoxylon Clavi-Herculi), guaco (Aristolochia grandiflora), contrasting strongly to our small species of aristolochia, linoleum (Amyris lignale), cedar (Cedrela odorata), for cigar boxes, Brazil wood (Cæsalpina crista), Campeachy wood (Hæmatoxylon campeachiaum), dragon's blood (Pterocarpus Draco), many magnolias, Schinus molle, known as pepper tree, and which was used so much this past season as a decorative shrub on the fair grounds, especially around California building, cypress (Taxodium distichum), pitch pine (Pinus communis) and many forms of cactus wood. To represent their oaks, of which they have many species, they showed Quercus Virens or live oak, and claim it as the most durable as well as the strongest. The balsamo (Myroxylon Pareira) is one of their hardest, and used principally for railroad sills. Zopilote, an ash (Fraxinus trilobata) or Turkey buzzard tree, is a very common one; it has a smooth brownish bark, which annually peels off, depositing itself at the base of the trunk in large quantities and emits on fermentation the odor of musk. Mora excelsa, one of order Mimosæ, yields 75 per cent. tannin, according to their statement, and is found not only in the bark, but the wood itself. They call it Granadillo.

Spondia canescens furnishes a very hard wood, but as they say, its great peculiarity is to concrete its sap, in amber colored crystals as hard as flint, thereby completely inutilizing the implements of the workmen. Last that I shall mention from this country is the sweetest of all chictzapotl chicle (Sapota achras), which forms the most beautiful evergreen tree in the country.

Here we are now in Central America, but not in Forestry Hall, as they have their own buildings. Guatemala and Honduras in one and Costa Rica in another. The former did not lack material, but their method of exhibition was bad and also suffered much by neglect. The same could be said of Costa Rica's crude drugs, but her woods occupied conspicuous space on ground floor. They were arranged in two pyramids about 15 feet in diameter and same height, composed of tree sections and slabs, varying from 2 to 6 or 8 feet in length.

Among them we noticed zapotillo, laurel, quebracho, guayacan, roble, ten or fifteen varieties of cedro or cedar, cocobolo, sangre draco, palma, zapote, manzanillo and algarroba.

Venezuela's woods on exhibition were reduced to the number of 15 or 20, and no information was attached nor could any be obtained elsewhere.

In the Liberal Arts building was a fine display of the natural resources of Jamaica, and prominent among them was a large number of woods in slab form and condition; no attempts at classification, and nothing could be learned of them, to the great regret of those having them in charge.

Hayti had a very clever collection in her own building, arranged in the form of a large pyramid in a corner of the building and containing large specimens in natural and polished condition of these tree bearing official drugs or those closely allied to them: Xanthoxylon caribbean, Catalpa longisliqua, Bignonia arborea, Acacia arborea, Tecoma leucoxylon, Piper aduncum, Mimosa anjuscacti, Chiconea floribunda, Theobroma guozumi, Guaiacum officinale, Simaruba excelsa, Hæmatoxylon Campeachiaum.

Trinidad, or as their genial commissioner calls it, "The Land of the Humming Bird," showed fewer timbers but larger boards or slabs and finer colored woods than any other country. Also the only one exhibiting the purpleheart or amaranth, a species of copaifera. This resembled very much the heart wood of our red cedar, but durable in color and had very small portion of white duramen.

These woods were all board size, 1½ feet to 3 in diameter and 8 or 10 feet long, one half natural, the other polished, and besides the purpleheart were the galba, resembling cigar box cedar, locust, a dark red wood, guelpha, creamy white, very close grain, resembling a maple, tapana, reddish walnut color, and used for carriages, fustic, logwood, balata, roble, Guava pigeonwood, Spanish ash, and Copaifera officinalis.

British Guiana had a small collection of her timbers, and all highly polished.

Brazil's forests were represented by some 441 specimens from the state of Amazon, and among them please to note castanheira (Brazil nut) (Bertholetia excelsa), copaiba, cumara (Dipterix odorata), divi divi, cedro, audiroba, saboneta (Sapindus saponaria) and ucuhuba (Myristica sebifera). These are all useful timbers there, and few, if any, ever exported to this country.

Paraguay showed some 300 timbers, varying from 12 inches to 4 feet diameter, and most of them being polished slabs from which the bark had been removed and usually of that dark color so common to that country, Brazil and Argentine.

Argentine Republic succeeded finely as a country in showing her woods, as nearly every state responded favorably to the call, about 22 altogether, also 85 or 90 individual exhibitors.

The interest manifested was entirely too great for their allotted space, and about one-fourth only could be exhibited and remainder stowed away under platforms, tables, etc., and same inconveniences happened to their plants. They had 1,000 or 1,500 specimens of these and not space enough to place one in view. The timbers were of commercial slab size and mainly the dark varieties shown by private individuals, while the government showed the trees in lengths of 4 and 5 feet, with the bark remaining for one-third the length, while the remainder was half natural and half polished, so that the tree was presented in three conditions.

These principal ones were algarroba for walnut, mistol, roble, cedrela for cigar boxes, Palma nigra, black palm for ornamental posts, quebracho (Aspidiosperma Quebracho) resembles our white oak (Quercus alba) both in bark and wood.

Juglans Australis, their only walnut, approaches our black very much in color and grain.

Quebracho Colorado, another useful one, and also a great tannin producer, nearly 24 per cent., and also as a substitute for æspidiosperma.

Another wood resembling our walnut is the algarroba (Prosopis juliflora and nigra), and is actually exported as a substitute for it.

This belongs to order Leguminosæ, as does also Cæsalpinia melanacarpe, another walnut substitute.

Zapello (Pisonia zapello), laurel (Ocotea suaveolens), Quillaya Tellowiana and Eugenia pungeus are other important woods, making excellent durable timber.

They took great pride also in their tanning materials, and among the prominent barks and fruits for that purpose were these:

Acacia angice and abramontana, Psidium guava, Ocotea suaveolens, or laurel, Nectandra posphyne, root of mistol (Zizyphus Mistol), fruit Cæsalpinia Melanocarpa, barks of Juglans australis and Aspidiosperma, Croton succirubra, Berberis ruscifolia and Eugenia Michaela.

In striking contrast to their woods they showed the following, of which you may know something: Honey locust (Robinia Psuedacacia), alder (Alnus ferruginea), maple leaved negundo (Negundo Negundo). Many of our common beeches and the weeping willow (Salix Babylonica).

From Europe we had the excellent display of cork and cork tissue; from Spain also tans, dyes, licorice, collections of wood, including a very complete one from Philippine Islands. Mahogany from Cuba and Porto Rico.

France not only finely illustrated what they were doing to perpetuate forests by showing us their reports of directors and inspectors of forestry, which were very complete, but showed us many blocks of wood 8 × 12 inches and 22 inches thick with bark removed and surface polished, some dye materials and valuable knobs for veneers, some of which were valued as high as $1,000; also a good collection of seeds and cones. Adjoining France was Siam's exhibit, consisting of 20 or 30 pieces of wood, well polished, but not named. A handsome council table of teak wood attracted considerable attention. In spite of printed warning "Hands off," hands were "on" entirely too often. The names of vandals have a wider reputation this Columbian year than any previous one.

Some cordage also claimed our attention as composed of the long rattan. They find it much more durable than manila, even for cables. Edible birds' nests proved an attraction, if not a delicacy.

The series of rattan baskets were unique and very artistic; they were made entirely by convicts, but the prices were most surprising.

The Javanese had similar work and much cheaper.

Germany had no exhibition of woods, or so few as not to be noticeable, but showed these fine wood productions: Beer casks barrels, tubs and vats; also cork in its varieties.

The Forest Academy showed the scientific methods of forest culture as practiced in that country.

Sweden showed wood pulp industry and cellulose derived from spruce trees, but no attempt to represent timbers.

Russia's exhibit was characterized by crude and manufactured material from the linden bark fiber (Tilia Europea), and comprised nearly everything, from shoes for the sole of the foot to thatched house to abide in. Shoes, slippers, rough garments, kitchen utensils and other household articles, matting, brooms, brushes, planking, thatching and many others, which we could not stop to consider, but the whole line was very interesting to every one.

They had also many fine sections of timbers, but no cosmopolitan classification, and we could decipher very little information concerning them.

The administration of crown lands gave a finely illustrated idea of timber and its culture, diseases of trees, medicinal plants and roots, gums and resins and forest management, as also did the Forest Academy, of St. Petersburg, and the Russian Agriculture, Forestry and Mining Commission.

Japan conferred an honor upon us which, I fear, was little known, that of being the first country to receive a display of her woods outside of her own, or any attempt to represent them in a foreign land. I have reason to believe that Philadelphia museums will eventually receive the entire forestry collection, as their courtesy toward Philadelphia people was decidedly marked, and the least favor more than reciprocated, notably the secretary of the commission, Mr. Shikasa Suwa, who took almost a boyish delight in those people who did ask questions, and was untiring in his efforts to please them.

The space allotted was entirely too small, and hence crowded inside and out, with scarcely space enough for an aisle.

There were two methods of showing woods, and in both cases were prepared timbers, bark having been removed. One style was a framed collection of the sections about 10 × 14 inches and about 20 or 25 to a frame, the other was by means of unpolished boards, 8 to 10 feet long, and the width of the tree.

Their attempts at labeling were very successful, and beside the technical name they had the common English name as well as the Japanese; also the general characters under which the tree existed and flourished, as well as its direct uses to man.

For their lacquer work the principal tree is the Paulownia (P. Imperialis), a tree which is adapting itself to our latitudes and proving a fine shade tree.

Another for the same purpose is zelkova kaki, one of the elm family, and still another is a horse chestnut (Æsculus turbinatus), called by them "Tochi."

Their largest trees are the cryptomerias, a class closely related to our Southern cypress, often reaching wondrous heights, and are the admiration of all visitors to that empire.

With that little relation of cryptomeria to cypress, we are able to find some of our genera represented by species close to our own. For that resemblance to relationship we feel very much at home among them. For instance, Taxus cuspidata, or yem, Thuya obtusa, or Arbor vitæ, Æsculus turbinatus, or horse chestnut, Tilia cordata, or linden, Morus alba, mulberry, Juglans Siboldii and regia, walnuts, Acer Japonicum and palmatum, maples, Fraxinus pubinervs, or ash, Magnolia hypolenca, or magnolia, Castanea vulgaris, chestnut, Alnusi firma, alder, Betula alnifolia, birch, Quercus acuta, gilva and glauca, as oaks, Diospyros Kaki, persimmon, Pinus densiflora, pine, Rhus succedaneum and vermicifera, near relative of our Rhus tox.

Paulownia we have established in this country, as also another Japanese, the gingko (Salisburia adiantifolia).

There are also three other trees which were represented by sections at the fair—Cedrela chinensis, Torreya nucifera and Cinnamomum camphora.

The department of agriculture and commerce had an exhibition of maps, plans and illustrations of forest growth, woods, plants, wax, resins and wood pulp for paper, bamboo cane and baskets, tanning material, etc. They also had as here represented in the group of the world in the center of Forestry Hall two bamboos, each over 70 feet long.

India's exhibit consisted of many fine pieces of carved wood, usually teak, timber in the rough, as well as fashioned to show to best advantage, specimen tans and dyes, oil-bearing substances, gums, resins and fibers.

We will limit this description to timbers, namely, those yielding drugs of our acquaintance and to the carvings.

The great mantel piece was compound of Shisham wood (Dalberjia sisso), redwood, walnut, boxwood, and some fragments of very old teak and blackwood, found in some ruins near Madras and dock excavations in Bombay.

The teak is about 600 years old and the blackwood dates possibly from before the Christian era.

The carved doorway of teakwood shown there is of the same design and general outline of those used in the thrones of different parts of the Mandalay palace, but the detail is more elaborate than anything the palace contains.

The triangular space above the door contains designs intended to represent the city of Mandalay, with the king and his courtiers.

The lowest tier shows the city wall, with one of the seven-roofed gateways; on and around this are the guardian "nats" of the city and other mythological figures.

The second tier is supposed to represent the king's ministers, and the highest represents the king and his queens in the palace.

It is executed by a Mandalay carver, under direction of Conservator of Forests, Upper Burma.

Among the timbers were the following arranged in well seasoned slabs, bark removed from most of them, and in various sizes and shapes—acacia, arabica, leucophloea, sundra, and catechu.

Acrocarpus fraxinifolius, used chiefly for tea boxes and shingles.

Ailanthus excelsa, a soft wood like the Ailanthus glandulosa common here. This is used by them for sword handles, spear sheaths, and catamarans.

For these boats, however, they use a better wood, Gynocarpus Jacquain, so light that its weight is but 20 lb. to the cubic foot.

In heavy contrast to this, however, is the Hardwickia binata, which is one of their ornamental timbers, and weighs 82 lb. to the cubic foot.

Wabo (Bamboo gigantea) is, as its specific name implies, a gigantic species of bamboo frequently reaching 125 ft. and 25 to 30 in. in circumference, and those on exhibition were 64 ft. long.

It is chiefly used in light work, scaffoldings, etc.

Bombax malabaricum is a curious wood which is white when cut, but turns dark on exposure, and strange to say is durable only under water.

Anacardium occidentale, another member of our cashew nut family, produces a wood moderately hard, used for packing cases, boat building, and charcoal.

Cassia fistula, very durable, but not strong enough for timber.

Satinwood, our hair brush acquaintance (Chloroxylon Smietenia), used for everything from agricultural implements to toilet articles.

Cedar (Cedrela Toma) is special adapted to carving and furniture, as it is not susceptible to attacks of white ants.

Ebony (Diospyros ebeneum) for inlaying, making marked contrast, also valuable for furniture otherwise.

Shisham (Dalbergia sisso) is a valuable tree for carving, also the species latifolia, as well as Melia Azrederach.

This is held very sacred by the Hindoos and their idols are made from it.

Cinnamomum glanduliferum for boat building, etc. Pterocarpus marsupium and Santalinum Strychnos Nux Vomica, and potatorum, all are useful, and teak (Tectonia grandis) is one of their best, for when it is well seasoned it does not crack, warp, or split, and is not injured by white ants.

Erythroxylon monogynum, used as a substitute for

* From the *American Journal of Pharmacy.*

sandalwood (Santal album), which is highly prized for carvings and incense as well as for perfume.

Tamarindus indicus furnishes a rich dark red wood.

Padouk (Pterocarpus indicus) is their most valuable tree for construction of furniture, and the Inspector General of Forests predicts a better future for this than teak or mahogany every had.

Ceylon had no collection of woods in Forestry Hall, but in their court in Agricultural building there was quite a fine display which proved uninteresting until the purchase of a Hand Book of Ceylon Courts, that proved itself the most valuable of its kind, as it treated briefly and pleasantly of the natural history of the island, botany, ethnology, language, religion, fibers, etc., agricultural and tea cultivation, besides being valuable for locating the different portions of these exhibits and for describing the different articles on exhibition.

The woods with somewhat familiar names were: Eugenia bracteata, Cassia fistula and siamea, Melia dubia, Diospyros ebeneum and five other species, Mallotus alba, Erythroxylon monogyrum, Pterocarpus marsupium, Strychnos Nux Vomica, Tamarindus Indica, Myristica laurifolia, Tectonia grandis, Albizzia odoratissima. Suringa-mara, one of their hard woods, is used to make pestles and mortars. Singhalese kind, however. Satinwood (Chloroxylon Swietenia) is as abundant and useful here as in India. Another valuable one is the "Nandoon" (Pericopsis mooniana), found only in Ceylon.

The tamarind produces a variegated wood, very ornamental, and but little inferior to calamander, which is a persimmon (Diospyros guecsita), the most attractive cabinet wood in Ceylon.

In this hand book a chapter is devoted to native medicinal plants and medicines, and I found it so interesting that I beg to quote a paragraph for the sake of Ceylonese polypharmacy.

"In most cases the treatment only serves to change an acute disease into one of chronic character, while recovery from a single affection is protracted, the patient being kept half starved on gruel and made to swallow huge quantities of infusions and decoctions of medicinal herbs, villainously compounded, the number of ingredients in each portion increasing in direct ratio with the continuance and severity of the malady."

A mild form of fever, for instance, would be treated with a decoction of the five minor roots—Desmodium gangaticum, Uraria lagopodioides, Solanum Jacquini, Solanum Indicum and Tribulus terrestris—which are believed to cure fever due to deranged phlegm, catarrh, etc.

A severer form would be ascribed perhaps to deranged air, requiring the use of the five major plants—Ægle marmelos, Calosanthes Indica, Gmelina arborea, Stereospermum suaveolens and Premna speciosa.

In remittent fever, etc., all ten may be prescribed together, and in typhoid fever, with head symptoms, all these with eight or ten others.

Many articles of their pharmacopœia were on exhibition, some not unknown to ours. The display of cinchona barks and cinnamons was very fine.

The exhibit of New South Wales was the only one in forestry from Australia, and a glance at it showed the excellent judgment of the commission in selecting those timbers which are most useful in their industrial arts, for their original intention was to show some 19 classes relating to forests and prepared woods, but there were but 6 on exhibition.

Two of the small ones will be considered now and the third later on.

Under class of dyes and tans, there were 3 large collections, and strange to say all the tans were genus Acacia, two (2) of wattle bark (Acacia decurrens) and one (1) of hickory (Acacia penninervis).

The wattle of Raymond & Co. analyzed 35·75 per cent. tannin and 39·5 per cent. extract.

The space allotted Australia was neatly inclosed by a sort of stockade effect in planks, nine (9) feet high and two (2) to three (3) feet wide, polished to half their length or more and labeled in vernacular. The classes of logs, worked timber, and ornamental woods will be considered together, as the best work of the Director General of Forestry was with these three (3) classes.

They consisted of various sized specimens sufficient to show best characters of them from the boards forming the outer wall of the exhibit, to herbarium size of wood and bark, 12 × 18 in. Chief of the large timbers were the mangrove (Avicennia officinalis), swamp oak (Casuarina glauca), forest oak (Casuarina torulosa), red cedar (Cedrela australis), rosewood (Dysoxylon Fraserianum), and 9 species of Eucalyptus, E. botryoides, bastard mahogany; E. crebra, gray iron bark; E. longifolia, woolly butt; E. macrorrhyncha, stringy bark; E. microcorys, tallow-wood; E. pilularis, black butt; E. paniculata; she or pale iron bark; E. poprulifolia, red box; and E. resinifera, forest mahogany.

Also these indigenous trees, nine (9) species of Acacia of which decurvens is the most valuable for tanning purposes, as it yields from 25 to 35 per cent. tannin and is known there as green wattle.

Acacia peunerius, known as hickory, and Acacia salicina as native willow, apple tree, Angophora intermedia, black oak as Casuarina suberosa, sycamore, Cryptocorya obovata, sassafras, Doryphora sassafras, white tea tree, Melaleuca leucadendron, and 18 species Eucalyptus.

Of the herbarium sizes there were 105, showing bark on one side and wood on the other, and included 17 species Acacia, 5 Casuarina or so-called oaks, 19 Eucalyptus, 6 Melaleuca and the remainder in genera not specially interesting.

Eighty (80) species, showing seeds and seed vessels from the following and others: 10 Acacias, 5 Casuarinas and 26 Eucalyptus; 107 barks, principally Acacias and Eucalyptus; 27 of the latter were noted and 5 of former, Mallotus philippinensis, Dubolsia myoporoides, etc. These were about 12×18 in., and banded by a thin strip of metal, and suspended, when they formed a most pleasing part of this exhibition, and the 27 Eucalyptus were the most interesting of the section. For outside the interest with which we consider them in materia medica, they are a wonderful class to all who stop long enough to compare one species with another, as, for instance, the great variation in the bark is of itself startling; there are all gradations from the smoothest to the roughest and most deeply fissured we have in any tree, all to be found in this one genus Eucalyptus, and as strange as the barks were startling are some of the vernacular names applied to these trees.

Besides those mentioned previously are such as these: Yellow box, swamp mahogany, blue gum, spotted gum, white box, bloodwood and peppermint; consequently they specify this as pipetta.

The commission showed also in another class photographs of their typical trees.

Woolly butt (Eucalyptus longifolia), 230 feet high and 33 feet circumference.

Black butt (Eucalyptus pilularis), 280 feet high and 59 feet circumference.

Spotted gum (Eucalyptus maculata), 300 feet high and 18 in circumference.

Native fig (Ficus macrophylla), 250 feet high and 36 feet circumference.

River oak (Casuarina glauca), 120 feet high and 16 in circumference.

Turpentine (Syncarpia laurifolia), 200 feet high and 30 feet circumference.

In conclusion I might say that there are about 50 species of Eucalyptus in Australia, and all useful in some way or other, but chiefly in those cases when strength and durability are desired. They resist both fire and water, therefore very little in demand for fuel.

These also rank as the highest trees of the world, as the species Amygdalina was found with a diameter of 81 feet and a height of 480 feet, and according to some authorities this is 150 feet higher than the Sequoias of California.

So at this nearly antipodal pinnacle or tree top, I will leave you to draw your own conclusions, whether or not this World's Columbian Exposition was the most colossal of its kind, and its forestry feature a pronounced success.

[Continued from SUPPLEMENT, No. 960, page 15342.]

EXTINCT MONSTERS.*

A BRIEF ACCOUNT OF SOME OF THE MOST REMARKABLE FORMS OF ANIMAL LIFE IN THE PAST HISTORY OF THE EARTH.

By STEPHEN BOWERS, A.M., Ph.D., editor of the *Fallbrook Observer*, Fellow of the Geological Society of America, Corresponding Member of the Geographic Society, Philadelphia Academy of Sciences, Member of the Philosophical Society of Great Britain, etc.

FLYING DRAGONS.

IT was a long time before learned men would admit that a flying dragon was possible. But the research of the geologist has brought their remains to light, and they are as well known to-day as the Dinosaurs or the Mammoth. They navigated the air in the long past, and were contemporary with the Ichthyosaurs, Plesiosaurs and Dinosaurs, whose characteristics we have already described, as well as many other reptiles. They are known as Ornithosauria, or bird lizards, because they are partly saurian and partly bird-like.

Among these extinct flying lizards are Pterodactyls, a name derived from the Greek *pteron*, wing, and *dactylos*, finger; hence they are called "wing-fingered" creatures. They had the power of flight, "not by a membrane stretched over elongated fingers, as in the bat, nor by a wing without distinct and complete fingers, as in the bird, but by a membrane extending from the arm to the tail, supported chiefly by a greatly extended little finger, the other fingers being short and armed with claws." The remains of many flying dragons have been found, varying from that of a sparrow to monsters whose spread of wing probably exceeded twenty-five feet.

These singular reptiles could, most likely, perch on trees or hang on the side of perpendicular cliffs, or stand on the ground or swim in the water. They probably walked on all fours, as some Dinosaurs, or on their hind feet at will, or they could dive into the water in quest of fish. Indeed, they possessed the characters in part of reptiles, mammals, and birds, and it is difficult to determine which predominated. They had four fingers, and were furnished with claws, while birds have but three fingers in hand or wing. All mammals have a skull joined to the backbone by two articulations, while Pterodactyls have but one, as in birds and reptiles. Their jaws show that they were constructed on the reptilian plan and not mammalian. They had powerful muscles in the region of the chest to enable them to fly. They doubtless had lungs like birds, and their bones were supplied with air by an elaborate system of air cells; but this does not argue relationship with birds. They were probably warm blooded.

Many of these strange creatures had enormous teeth, conical and the points turned backward. The large forms found by Professor Marsh in the Rocky Mountain region, however, were without teeth, but their enormous beaks were horn-like. One can imagine that a monster "bird" (if such it could be called) with a spread of wing of twenty-five feet, large head and neck, and beak of horn, two or more feet long, would be a formidable antagonist in combat with other forms of life. The Pterodactyl had large eyes, giving it powerful vision. It had a long tail, and, when flying, must have resembled a boy's kite. Its neck must have assumed the shape of the letter S in order to support the large head and give equipoise to the body generally. It had no feathers, but probably folded its leathery wings when at rest.

"Half-vampire, half-woodcock, with crocodile's teeth along its tapering bill, and scale armor over its body, it was qualified," says Dr. Buckland, "like Milton's fiend, for all elements, the creature was a fit companion for the kindred reptiles that swarmed in the seas or crowded on the shores of a turbulent planet:

"The fiend
O'er bog, or steep, through strait, rough, dense or rare,
With head, hands, wings, or feet, pursues his way,
And sinks, or swims, or wades, or creeps, or flies.

"With flocks of such like creatures flying in the air, and shoals of Ichthyosauri and Plesiosauri swarming in the ocean, and gigantic crocodiles and tortoises crawling on the shore of primeval seas, lakes and rivers, air, land, and sea must have been strangely tenanted in these infant days of our land."

* From the author's pamphlet.

These lizards or flying dragons began their existence in what is known as the Jurassic period, culminating toward its close, and extending to the termination of the succeeding period, the Cretaceous, when they suddenly disappeared. Many geologists have been greatly puzzled at the sudden disappearance of forms of life at various stages in the geological history of the earth. But the Vailian or Annular theory clearly explains this in the fall of the rings of overcanopying vapor containing much of the solid matter now composing the crust of the earth. It swept them from the slowly forming world, giving place to other forms of life which succeeded them. It must be remembered that the geologic history of our earth can scarcely be counted by years. Every leaf in the great Stone Book declares that time is long. In our next we will have something to say of the old sea serpents of the past.

SEA SERPENTS.

The great Stone Book furnishes the remains of marine reptiles which propelled themselves by means of their tails and elongated bodies. They also had fins, and while, strictly speaking, they were not serpents, but saurians, nevertheless the name serpent has been accepted by geologists, and we use it in that connection in this chapter.

The remains of one of these monsters was found embedded in the rocks in Europe more than one hundred years ago. In blasting a tunnel in the mountains near Maestricht, a city in the interior of the Netherlands, the huge jaw of a sea serpent was laid bare. It was about four and one-half feet long and two feet wide, with numerous teeth, some three inches long. The backbone consisted of one hundred and thirty-one vertebræ, of which ninety-seven belonged to the tail, the total length of the skeleton being about twenty-four feet. It was named Mosasaurus, from the river Meuse. Later discoveries show it to have been a marine reptile of great strength and activity, having a large tail flattened vertically and capable of being moved from side to side with rapidity, making it a powerful organ of propulsion. But the largest forms of this great saurian have been found in America. In the great inland Cretaceous sea which once covered the spot now occupied by the Rocky Mountains they lived in prodigious numbers. In that ancient sea they seemed to have reigned supreme. They were carnivorous in their habits, and attained a length of seventy-five or eighty feet. The museum of Yale College has a collection of more than fourteen hundred skeletons of these great sea lizards. More than fifty species have been discovered in this country. They had large, flat heads, conical in shape, with eyes directed partly upward. They had two pairs of paddles or flippers, and, like snakes, were furnished with four rows of formidable teeth, conical and recurved. Each half of the lower jaw was articulated, as in true serpents, permitting them to swallow their prey whole.

The reader must bear in mind that Mosasaurus was a long, slender reptile with powerful paddles in front. The tail was long, flat, and deep, like that of eels. A genus known as Clidastes, found in Kansas, is noted for its slender body, reaching a length of forty feet. Some of these sea reptiles had sclerotic plates in their eyes, forming an optical instrument of varied power, that, like the Ichthyosaurus, could use it as a telescope to see in the distance, or as a microscope to see an object near by. One species had a long projecting muzzle similar to the snout of a sturgeon.

Other marine reptiles lived at the same time, but with thicker bodies, called Elasmosaurs. This group is not yet fully worked out, but sufficient is known to believe that they were monsters indeed, some attaining a length of one hundred feet. They strongly resemble Plesiosaurs, which we have already described. They seem to have been able to live on the land as well as in the sea. They had very large teeth with strongly marked ridges. Professor Cope describes the monster in the following graphic style: "Far out on the expanse of this ancient sea might have been seen a huge snake-like form, which rose above the surface and stood erect, or swayed about, describing a circle of twenty feet radius above the water. Then, plunging into the depths, naught would be visible but the foam caused by the disappearing mass of life. Should several have appeared together, we can easily imagine tall, flexible forms rising to the height of the masts of a fishing fleet, or like snakes twisting and knotting themselves together. This extraordinary neck—for such it was—rose from a body of elephantine proportions. The limbs were probably two pairs of paddles, like those of Plesiosaurus, from which this diver chiefly differed in arrangement of the bones of the breast. In the best known species twenty-two feet represent the neck in a total length of fifty feet. This is Elasmosaurus-platyrus, a carnivorous sea reptile, no doubt adapted for deeper waters than many of the others. Like the snake bird of Florida, it probably often swam many feet below the surface, raising the head to the distant air for breath, then withdrawing it, and exploring the depths forty feet below, without altering the position of its body. From the location in which the bones have been found in Kansas, it must have wandered far from land; and that many kinds of fishes formed its food is shown by the teeth and scales found in the position of the stomach."

SOME NEW WORLD MONSTERS.

Far back in Eocene times a great inland sea occupied much of what is now known as the State of Washington. Its shores and islands were covered with a tropical vegetation, among which roamed innumerable animals. Some of these forms were as curious as the imagination can well conceive. One of the most singular has been named by Prof. Marsh Dinocerata or terrible horned monster. In appearance it resembled the rhinoceros, the elephant and the hippopotamus. From the skull rose six bony protuberances which probably supported three pairs of horns. The two canine teeth of the upper jaw developed into long dagger-shaped tusks. The limbs were strong and massive and the head large, but the brain exceedingly small. The body of a full-grown form was about twelve feet long and weighed fully six thousand pounds. From the position in which these remains were found, it is believed they roamed through the tropical forests in vast herds. It was abundant for a long time, or until the close of the Eocene period, when it suddenly disappeared.

Into the old Eocene sea, of which we have spoken,

flowed numerous rivers which continually brought down sediment from surrounding elevations which gradually filled it to the depth of more than five thousand feet, in which repose the fossil remains not only of Dinocerata, but numerous other forms of life. As this inland sea gradually filled with sediment other streams led out, cutting deep gorges until it was drained completely dry, and there was no more sea in that region.

In the Eocene beds referred to, Marsh found the earliest representatives of the horse family. Eohippus, which means dawn horse, and Orohippus, mountain horse, were found here. They were about as large as a fox. In front they had five toes and three on the hind foot. The two bones of the leg now united were then separated. In the lower Miocene the Mesohippus made its appearance with a small, but useless, fourth toe, and the leg bones united.

Next comes the Protohippus, an animal larger, and more like the present horse. In this the fourth toe has disappeared and the two side ones are short and useless. The Pliocene period developed Pliohippus with a single full toe, and small remains of the two outer ones, while the Quaternary period gave us the modern horse, with the fully rounded and single-toed hoof, the side toes being reduced to simple splint bones. The remains of this horse have been found at the head of Oak Street, Ventura, and different portions of Ventura County.

More than forty species of the fossil horse have been discovered, and while it cannot be properly classed as a "monster," yet the Pliocene and Quaternary periods yielded much larger species than now exist on the earth. The horse seems to have disappeared from this continent before the advent of man, and those he introduced are believed to have come from Asia or Africa.

In the country east of the Rocky Mountains the remains of another strange group of quadrupeds have been found. One of these which Prof. Marsh names Brontops lived after Dinocerata had passed away. They were probably larger than the former animals, and flourished in Miocene times. Brontops resembled the rhinoceros in some respects, but was larger. On its nose it supported a pair of stout horns. Its skull was long and large, measuring in a full grown form three or more feet, and the ends of the horns were nearly two feet apart. The fore feet had four toes and the hind feet three. It seems to have had an elongated and flexible nose like that of the tapir and the body was covered with hair or bristles.

When Dinoceras was living in such great abundance in tropical Wyoming, the jungles swarmed with other forms of life. Large rodents with heads a foot and a half long, the early horse, monkeys, foxes, wolves, a cat nearly as large as the modern lion, rhinoceros, camels, stags, and serpents existed and the waters were filled with fishes—some of strange forms—reptiles, etc.

SOME OLD WORLD MONSTERS.

India furnishes some as strange forms of ancient life as any other country except America. At an early period in the Tertiary era it was a large island, but subsequent upheavals formed it into a continent. The uplift was probably gradual, as was that of the Sivalik Hills, which stretch along the southwest part of the Himalayas. In the strata composing those hills are found the remains of quadrupeds, birds, fishes, molluska, and crustaceans. Elephants and mastodons once lived here in vast numbers, several species of rhinoceros, hippopotamus, horse, camel, ox, stag, antelope, and other animals.

But one of the most singular animals known to paleontologists is the Sivatherium, and which has never been found elsewhere, we believe. It was a large stag with four horns, and is supposed to have had the bulk of the elephant, but a greater height. It belonged to the deer tribe, and was probably the most gigantic specimen that has ever existed. The fore horns were short, but the two horns behind those were expanded, and were doubtless formidable weapons of defense. The Sivatherium gives us "a new type which seems to connect together two families, at the present time well worked off from each other, namely, the giraffe and the antelope." Its teeth resembled those of the giraffe, but its horns resembled certain antelopes. Its head resembled that of the ox in certain particulars, but was much larger. The upper lip terminated in a short proboscis, as that of tapirs. Altogether it must have been a strange-looking creature.

Another noticeable form from the same beds is that of a giant turtle. This monster when living must have been twenty feet long, with a shell or carapace twelve feet in length, and was probably higher than a tall man. A single arm bone measured nearly two and a half feet. It is believed to have had a foot as large as that of a rhinoceros. It lived in an age of giant mammals and reptiles. The Sivalik forms included not only the great variety of animals that we have named, but also crocodiles, lizards, and snakes. It is estimated that at the time when this great turtle and Sivatherium existed in India there were five times as many animals and reptiles as are now found living there.

SOUTH AMERICAN MONSTERS.

South as well as North America has yielded some grotesque forms of life in the past. One of these, named by Cuvier Megatherium, from the Greek *megas*, great, and *therion*, beast—great beast—was allied to the sloths, ant eaters, and armadillos. It was nearly twice as large as the rhinoceros. One skeleton obtained in Pampas strata measured eighteen feet. The limbs exceedingly massive, the femur being three times as thick as that of the elephant. In circumference it was equal to the entire length. The tibia and fibula were united and cemented together. The tail was very large, and when this massive edentate stood on its haunches it formed a tripod similar to some of the Dinosaurs. The hands terminating the arms were a yard long, and were armed with powerful claws. The teeth, which were ten in number in the upper jaw and eight in the lower, and eight or nine inches long, had a grinding surface of triangular ridges. They had the peculiarity of continual growth from new material from beneath, which caused them to last as long as the animal lived.

Another peculiarity was that they were hollow prismatic cylinders. The snout and lips were elongated into a slight proboscis, and the animal had a long and powerful tongue with which it could strip the small branches of trees. Its skeleton indicates an animal of prodigious strength. Its arms were very long and it was doubtless capable of breaking down large trees, from the foliage of which it fed. Dr. Buckland says its entire frame was an apparatus of colossal mechanism adapted exactly to the work it had to do.

Another form of extinct sloth is the Mylodon. It was ten or twelve feet in length, and much larger than the buffalo. Still another form is known as Scelidotherium, which was as large as the polar bear. Its remains are found in great abundance in the vast estuary deposits which form the Pampas. It inhabited South America during the Pliocene period. It, however, is not confined to South America, but its remains have been found both east and west of the Mississippi River and on the Pacific slope. The renowned footprints found near Carson in sandstone strata, and first believed to be human, were doubtless made by a giant sloth. Indeed, the remains of the animal have been found in the same strata.

The Glyptodon, another South American form, was a gigantic armadillo. It was covered with a carapace or cuirass of plated armor that extended over the head and along the tail. The vertebræ of the backbone were fused together, forming a hollow tube, and joined to the under surface of its great shield to which the ribs were united. The total length of this singular animal was nine or ten feet.

(To be continued.)

AVIAN ATHLETICS.

By MAURICE THOMPSON.

THE study of athletics, just now so popular, may be my excuse, if I need one, for spying upon my friends the birds, and reporting their gymnastics. One of the three things, yea, four, that passed the understanding of the old writer in the Bible was the "way of an eagle in the air;" and to this day, how a buzzard sails has not been satisfactorily explained.

Last November my attention was called to a flock of hawks (I do not pretend that the phrase is technically good) going southward high in air, moving by circular flight, each horizontal ring of advance forming a link in an imaginary chain which was to connect our frost-sprinkled climate with the warm, dreamy spaces of the South. Looking through a strong binocular glass, I followed the birds therewith till they passed beyond the horizon; and not a wing did I see make a stroke, save at long intervals an oar-like dip, as if merely to relieve the tiresome strain on the muscles.

Round and round they sailed, more than a hundred of them, a great giddy wheel rolling flat against the sky and gradually sinking from zenith to horizon, shrinking, shrinking, until, at the point of disappearing, they glittered like a silvery whiff of chaff just above the hills far southward.

I call that an incomparable display of aerial athletics. From how far north they came or to what southern point they went I do not pretend to know; it is enough that as far as I could see them they went on and on, apparently without effort.

There was a description in a newspaper the other day of how a hawk caught a carrier pigeon. The writer said that so long as the pigeon flew in a straight line it gained and drew away from its pursuer: but as soon as it began to zigzag the hawk overtook it. This brought to my mind what I once saw in the woods. A blue-tailed hawk was pursuing a turtledove; the flight seemed as swift as that of an arrow, although it was through a close growth of maples and beeches. Over and under boughs and around the boles of trees the birds whisked, apparently reckless of direction, and yet neither ever touched even a twig. How could eyes see and wings evade the multitude of obstacles behind obstacles? At last, when the hawk was within two feet of its victim, the latter dashed headlong into a flicker's hole in the body of a dead beech. Now think of it: that hawk was going faster than ever express train went, and yet it applied brakes and stopped short before reaching the tree! Speak of readiness, dream of what instantaneous response to exigency is, and then think of that movement; it was quicker than the burning of powder.

I have often wondered at the ease with which a great hen hawk drops from on high, like a falling shot, hitting so accurately its quarry on the ground; for at the moment of beginning its descent it closes its wings almost tight against its sides and goes as true as a plumb line. Before it reaches the ground its speed becomes so rapid that you hear the air fairly shriek through its feathers, and the heavy thud of the blow at the last is of deadly suggestion. I have seen a full-grown hare snatched up into the air limp and dead after such a performance and borne away dangling in a grip of fate.

An expert trapeze man does many wonderful things: but his extremest cleverness cannot equal that of a hawk which I saw dart under a flying kingfisher, turn back downward, and catch the bird in the breast.

Hawks, however, are not more expert than kingfishers themselves. The belted halcyon makes an unerring missile of himself when he sees a minnow shining in a pool of the brook, and from fifty feet distance goes, like a blue flash, to the silvery point. Chuck! Up leap a thousand shining drops and fall around like rain, while that animated and winged fish-spear comes forth from its plunge with the minnow safely held. Well may Halcyon giggle a raucous, clattering strain of joy; he has done what no man of us can learn to do.

The drowsy-looking little pewee flycatcher of our woods does almost impossible feats of agility in taking on the wing some species of dancing insects. I have seen one of these birds turn three or four complete somersaults in the air before finally he caught his gnat, which, like Galatea in the idyl, skipped hither and yon and up and down, after the manner of a harl of dry thistle down—ὡς ἄπ' ἀκανθαις ταὶ κατυρραὶ χαῖται—but there I go again; and a critic (of a sort) recently warned me that if I kept on with Greek I should soon be no better than Matthew Arnold and John Milton! As I was about to say, however, a kinsman of the pewee, the tyrant flycatcher, shows how a light and plucky tilter in the fields of air can outdo his most savage foe, by dint of superior cleverness at lofty tumbling. Many a time have I seen him bobbing up and down above a worried and disheveled hawk so high in the air that he looked like a bee harassing the wide-winged thing, mounting and hurrying through the hyacinth spaces of a summer sky.

Our black-capped titmouse is inimitable as a trapeze performer when he gets good hold of a twig's end. He can swing head downward, sidewise, curved till beak and tail touch; swing by one foot, and the wind may blow as hard as it can, he never loses his grip. No wonder Emerson loved him for his pluck and nerve. Some years ago it created a stir in old London when an athlete climbed to a temple's arch and hung head downward from a beam; but what is a feat like that when compared with what you may see any June morning when a titmouse hangs by one claw to the topmost leaf of some tall forest tree, and the wind blowing boisterously.

Have you ever seen two cock bluejays fighting in midair? There is a joust of brilliance! They whirl over and over so fast that they look like a blur of amethyst smoke, shot with gleams of white fire, and how their wings clash and their bills clack! Not much harm is done; but I venture to guess that no two human prize fighters (but are they human?) can give and take blows so rapidly.

The mocking bird, greatest of all the wildwood singers, has his own way of showing off his athletic nimbleness and grace. He somersaults backward in the midst of a staccato strain and never loses a note. Let some tenor try it in the opera one of these fine evenings.

All the woodpeckers climb the boles of trees not by stepping one foot at a time, but by jumping vertically. This may at first thought seem easy, yet a little reflection will disclose how difficult it is. The bird does not use its wings, and of course must spring upward and at the same time keep within reaching distance of the tree. Let a man try it with his two feet or two hands, no matter how well armed with spikes or claws, and he will, trained athlete though he be, certainly have a good, thumping fall for his pains. And more difficult still is the nuthatch's hopping headforemost down a tree stem, yet he does it with as much ease as you walk on the ground.

The great pileated woodpecker will hang to the underside of a branch by the grip of his toes, and hammer away for hour after hour without changing his position, when every powerful stroke is upward, and the heavy strain on his short legs is never relaxed.

Large migratory birds, the cranes, herons, geese, brant and the like, fly steadily night and day from Florida to the far North without rest, water or food, and at a rate of speed almost incredible. I do not know that they semi-annually go into training for their long flight, as our oarsmen and sprinters and football players must do before they can trust themselves to stand the strain of any, even the shortest, contest.

We have all read of the tireless flight of the albatross and have seen the pearl-white seagulls wheel about from daybreak to nightfall; but to me the pelicans seem to undergo the greatest strain that birds can bear. It makes me tired through sympathy to watch them feeding. They seem to fly so heavily while curving above the sea, and when they strike down at a fish it is the dash of a great hulking bulk into the water. For hours and hours up and down they go, a plunge and a rise, the constant flapping of enormous vanes, the ludicrous poising of a strangely overweighted head; it is a picture of stolid persistence, of activity almost prevented by bulk and ill shape. Yet watch a pelican with a good glass, and you will see that he is as sure of his strike as the kingfisher. His apparently awkward tumble into the flashing white caps is, after all, an amazingly accurate shot at a nimble mullet which he literally brings to bag.

The beautiful silver-breasted kite of our Southern States occasionally performs the feat of letting fall his prey and catching it again before it reaches the ground. A fine sight it is when he goes earthward from the clouds like a white bolt. I saw one drop a water snake which must have fallen fifty feet, wriggling and squirming, when the kite, so high that it looked like a forked-tailed swallow, shot down after it. With half closed wings it whistled through the air so swiftly that my eyes could scarcely follow, and struck the reptile just before it touched the earth. I have seen a red-headed woodpecker in the same manner catch a beechnut that he had let fall.—*The Independent.*

KERNOT ON WIND PRESSURES.

PROFESSOR KERNOT, of the Melbourne University, has read a paper on wind pressures before the Australasian Association for the Advancement of Science. The author referred to the great inconsistencies appearing in engineering and architectural practice with regard to the wind bracing of exposed structures, and to the great variation in the anemometric results published by meteorological observatories. Some of these have recorded pressures or velocities corresponding to pressures of 90 or 100 lb. per square foot, while others report results only one-third as great. It was pointed out that these latter results correspond fairly well with common experience of railway carriages and chimneys, great numbers of which would overturn with pressures of not more than 30 lb. per square foot, and yet, as a matter of fact, do not overturn, and are publicly regarded as perfectly safe.

Professor Kernot has conducted experiments which tend to show that wind pressure varies with the square of the velocity; but he admits that further tests on a greatly extended range of velocities are needed. He has also devised an apparatus for determining the relative pressure of the wind on flat and curved surfaces of different figures. The apparatus consists of a screw propeller revolved in a tube at high velocities by means of a gas engine. In this way it was ascertained that the ratio determined by Stoney between wind pressure on the flat and on sloping surfaces, such as a roof, is just; but it was also found that this result applies only to roofs supported on their columns, under which the wind can blow freely. When the roof was placed upon a wall, as in an ordinary building, the wall deflects the current upward; greatly reducing the pressure upon the roof. If the wall is provided with a parapet of ordinary proportions, this effect is still more marked; the pressure being reduced to one-third of what it would otherwise have been. Experiments were made with the wind blowing in at the open end of a building having the sides and the other end completely closed; and it was found that the internal pressure tending to

lift the roof was equal to that of the wind upon a flat vertical surface. The pressure upon one side of a cube was found to be 0·9 that on a thin plate of the same area.

A lattice work in which the area of the openings was 55 per cent. of the whole area experienced a pressure of 80 per cent. of that upon a plate of the same area.

The pressure upon cylinders and cones was proved to be equal to half that upon the diametral planes, and that upon an octagonal prism to be 20 per cent. greater than upon the circumscribing cylinder. A sphere was subject to 0·36 of the pressure upon a thin circular plate of equal diameter. When a plane surface parallel to the direction of the wind was brought nearly into contact with a cylinder or sphere, the pressure on the latter bodies was augmented by 20 per cent. In conclusion, it was recommended that 30 lb. per square foot should be taken as the maximum wind pressure upon areas of not less than 300 square feet and 50 lb. for smaller surfaces in positions of full exposure.

THE FIXED STARS.

By Prof. EDWARD S. HOLDEN, Director of Lick Observatory, California.

OUR knowledge relating to the stars has long needed the addition of one fact. One question has hitherto remained unanswered, namely, What are the actual dimensions of the fixed stars? or, What is the actual size of any single star? The distances of a number of stars are quite accurately known, considering the great difficulty and delicacy of the determination. The masses of a few stars are known, and these masses are not very different from the sun's mass. This was to be expected, as our sun is a star, and the stellar masses ought to be of the same order of magnitude as the sun's. The chemical constitution of very many stars is fairly well known from spectroscopic observations. That is, we know of many stars whether the vapor of iron is or is not present in the atmosphere, and so on for other substances.

The motions in the line of sight—the line joining earth and star—of many stars are also well known from spectroscopic observations; and their motions in directions perpendicular to the line of sight have also been carefully measured by comparisons between ancient and modern determinations of their positions. Hence the absolute motions in space of a considerable number of stars are fairly well fixed.

When we consider the enormous distances of stars in general (which are more than 200,000 times the sun's distance in all cases) and the comparatively feeble light emitted by even the brightest stars (never more than one seven thousand millionth of the sun's light), it must be admitted that much has already been learned concerning them. One datum is still lacking. What are their actual dimensions, or what is the actual diameter of any one star? This question has hitherto remained unanswered, and it is a fundamental one. As the stars in general are of the same order of magnitude as the sun, as has already been said, it is reasonable to conjecture that they are also of the same order of size. But conjectures are not satisfying in science, though one is often forced to be (temporarily) contented with them.

I should like to insert a parenthesis here, to say that the readers of articles on popular science ought to be continually on their guard against accepting the conjectures of the clever writer as if they were admitted and accepted results. It is perfectly justifiable to conjecture where we cannot (yet) know. Indeed, no active mind can avoid doing so. Science is advanced by trying the conjectures that arise, whether they be true or false. But the line between conjecture and conclusion should be sharply drawn and explicitly stated. The reader should try to hold himself in a critical and not in a credulous attitude, and the writer should always be ready to say, I know this to be so within an error of 5 or 10 or 50 per cent. After this long parenthesis, which appears to me to be well worth making, I return to the matter in hand. The actual dimensions of the fixed stars. How are they to be determined? It is impossible to fix these diameters with even the largest telescopes. The telescopic image of a star is not an absolute point, but it is a very small brilliant disk. Unfortunately the size of this disk is not a measure of the size of the star. The disk is really produced by the telescope; that is, the image of a brilliant mathematical point would be not a point, but a small disk. Mere seeing, as with a telescope, no matter how large, will not solve this question.

A very remarkable apparatus has lately been devised by Prof. Michaelson, of the University of Chicago, for solving this problem and others like it. The principle of the device is too abstruse to be explained here. It must suffice to say that it depends upon the measurement of interference bands produced by the light of a distant object. If this distant object has a sensible diameter, an easy measurement made upon the bands will determine the angular diameter of the object. If this experiment is made in the quiet atmosphere of a laboratory, where all conditions are under control, the instrument is capable of wonderful performances. When we come to use it in the open air upon stars and satellites, the unsteadiness of the atmosphere introduces very great difficulties indeed. Experiments of this sort have been made at Mount Hamilton by Prof. Michaelson himself, and they indicate that the problem of measuring the dimensions of the stars on this plan will be a very difficult one, though the trial is well worth making.

It is not long ago that the angular diameter of one star has been determined at Mount Hamilton by Prof. Campbell, using a method which is simplicity itself. This method has never before been applied to stars, though it has long been used in spectroscopy. The solar atmosphere contains the vapors of many different substances, each vapor being so highly heated as to give out light. Speaking generally, we may say that these vapors are arranged in the sun's atmosphere in the order of their densities. The heavier vapors lie lowest, and the lighter ones—as hydrogen—are highest. We must imagine the sun, then, as a central mass surrounded by many different shells of different substances—vapors. When we look at such a body with the spectroscope, we can obtain a separate image of each one of these shells, one at a time. The spectral lines of the various shells will have different lengths because the shells have different diameters. The lines of hydrogen are longer than the lines of iron, and hence we know that the hydrogen shell is larger than the shell of iron vapor. If the hydrogen lines are twice as long, then the hydrogen atmosphere rises twice as high as the iron vapor, and so on.

This observation is not very difficult in the solar spectrum, but it was entirely unexpected when Prof. Campbell found a star (1 m. 30 degrees, number 3,689) which was surrounded with an atmosphere of hydrogen gas of such enormous extent as to be measureable. The hydrogen shell surrounding the nucleus of this star has an angular diameter of five seconds of arc. When the distance of this star becomes known (and observations to determine the distance are in progress), this angular diameter can be expressed in miles. Then for the first time we shall know the actual dimensions of one of the fixed stars.

This discovery differs from the ordinary discovery in that it opens an absolutely new field of information. If a new comet is found, we have a new and valuable opportunity for collecting information about comets. Many comets are known, and it is likely that we can do no more than perfect our previous knowledge. The epoch-making discoveries are those in which new methods of research are invented, or in which old methods are applied to new subjects, as in this case. Here a new field of knowledge has been opened, and entirely new information is at hand. Mr. Lick's great telescope has been successful in finding many new and important things, but no one of them is more important than this, its latest achievement.—*The Graphic, Chicago.*

GREENLAND AS A SUMMER RESORT.

IT appears that our old conceptions of Greenland, which have been in vogue so many years, must now be overhauled and altered to suit the style of modern style of thought. Here is Dr. Cook, of Brooklyn, who was surgeon of Lieutenant Peary's Arctic expedition of 1891-92, and ought to know something about Greenland, coming out with the announcement that the country notorious in tales of starvation and shipwreck, the country whereof the very name upon a dog day was once a chilling thing to think of—that country Dr. Cook declares is just the place for a summer resort. He has made arrangements to take one hundred pleasure seekers thither this summer. Furthermore, he promises that his party shall inspect the scenes of the adventures of Kane, Hayes, and Greely, and visit in its headquarters a real Arctic exploring expedition—that of Lieutenant Peary.

Set forth in cold print, the plan of opening Greenland as a summer resort is for a moment surprising; but whoever has read the narratives of late explorers must have been aware that the country was coming to something like this. It has long been known that at a certain season each year the coast of Greenland up to the seventy-eighth parallel is as easily accessible as the coast of Norway or of Alaska. As far north as Upernavik it is free of dangerous ice nearly all summer, and in July the pack in Melville Bay, dreaded by Arctic navigators, breaks up and floats south, leaving a clear passage across the east side of the bay to Cape York. Between Cape York and Smith's Sound is the so-called "North Water," open even in early spring. For two months, from the middle of July to the middle of September, a steamship may cruise along the sea wall of Greenland for upward of 1,500 miles without risk. Recent Arctic books have been tales, not of starvation and danger, but of comfort, health, and pleasure. Dr. Nansen, after his hard sledge journey is over, lies for days on the grass and revels in berries and basks in the sunlight. Professor Heilprin leads two expeditions to McCormick Bay, one to carry Lieutenant Peary there, the other to bring him back; both expeditions are jolly summer scientific excursions. Mrs. Peary spends one happy year on the shores of McCormick Bay, and returns to Bowdoin Bay, near by, for another. No one complains of suffering. In winter, of course, the temperature is low everywhere. In summer, it is low one hundred miles inland from the coast, upon the great snow desert, but near the sea and upon it the weather is delightful. Every one praises its warmth and its healthfulness. Nansen goes so far as to assert that the remarkable fascination which, as is well known, the Arctic regions have for every one who has visited them, is due chiefly to the invigorating quality of the air. "The Arctic is the most healthful zone in the world," he says.

If this view of the situation is the right one, if Greenland is a spot which one may visit without suffering, then undoubtedly it holds forth unique attractions to the pleasure seeker. Dr. Cook's excursion, if it turn out successful—and there appears no reason for doubting its success—will mark the beginning of an important epoch in the history of Greenland above Cape York; the epoch wherein civilization begins to put to use the territory which pioneers have cleared for it.—*Frank Leslie's Weekly.*

DIATOMS.

How to Find Diatomaceous Earth.—Mr. W. A. Terry, of Bristol, Conn., sends the following to the *Microscopical Journal:*

It is asked how we know when we have found diatomaceous earth. It is, of course, impossible to be absolutely certain until the find has been examined under the microscope; still a collector of experience and good judgment will make few mistakes. The fresh water deposits are almost invariably covered by a layer of muck or peat. A light colored stratum below muck will be either *lime, clay* or *diatoms*, if it is not *sand*. Sometimes *all* mixed. If the material dries of a light gray or ash color and is also light in weight, it is almost certain to be rich in diatoms. If the deposit is heavy, it is mostly clay or exceedingly fine silicious dust: it is always well to examine all such deposits under the microscope, and, if not rich, they may contain rare varieties.

The marine deposits underlying the peat of all salt marshes of the Atlantic coast always contain diatoms; in some localities these are comparatively rich, and frequently contain deep water forms. The diatoms are not equally distributed through these deposits, but are apt to lie in thin streaks or in pockets; and strata holding shallow water forms and those containing deep water kinds are sometimes in close proximity. Where ditches have been dug through these marshes for drainage, material containing very interesting varieties is frequently thrown up. Shallow water kinds usually predominate near the surface, and below are streaks of deep water forms alternating with those of brackish water down to a depth of over twenty feet in many places.

On the New England coast, it is not very unusual to find these deposits to be from thirty to fifty feet in thickness. Where the deposits were laid down by strong tidal currents, few diatoms will be found. They deposit in eddies and basins after the coarse sand has been left behind.

These hints will be sufficient to guide the efforts of persevering and intelligent investigators in search of diatomaceous earth; but they must understand that tiresome and disagreeable labor is inevitable, if they would win success. At some future time I will give more detailed instructions.

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